FINAL REPORT

WATER CONSERVATION STUDY

U.S. ARMY ALASKA (USARAK)
FT. RICHARDSON, ALASKA

Prepared for

U.S. ARMY ENGINEER DISTRICT
FORT RICHARDSON, ALASKA 99703

Under

U.S. ARMY ENGINEER DISTRICT, MOBILE
INDEFINITE DELIVERY A-E CONTRACT
CONTRACT NO. DACA01-94-D-0033
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EMC ENGINEERS, INC.

DENVER, COLORADO
ATLANTA, GEORGIA

DEPARTMENT OF THE ARMY
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By

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This report has been prepared at the request of the client, and the observations, conclusions, and recommendations contained herein constitute the opinions of E M C Engineers, Inc. In preparing this report, EMC has relied on some information supplied by the client, the client's employees, and others which we gratefully acknowledge. Because no warranties were given with this source of information, E M C Engineers, Inc. cannot make certification or give assurances except as explicitly defined in this report.

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LIST OF ABBREVIATIONS

A	-	ampere
COE	-	Corps of Engineers
CY	-	cubic yards
ECIP	-	Energy Conservation Investment Program
ECO	-	Energy Conservation Opportunity
EMC	-	E M C Engineers, Inc.
F	-	Fahrenheit
ft	-	foot, feet
ft^2	-	square feet
gal	-	gallons
gpd	-	gallons per day
gpm	-	gallons per minute
hp	-	horsepower
hr	-	hour
in	-	inch
kgal	-	kilo-gallon, one thousand gallons
kW	-	kilowatt, one thousand watts
kWh	-	kilowatt-hours, one thousand watt-hours
LCCA	-	Life Cycle Cost Analysis
LF	-	linear foot (feet)
MES	-	M.E. Simpson Co., Inc.
mi	-	mile(s)
O&M	-	operation and maintenance manual
rpm	-	revolutions per minute
SIOH	-	supervision, inspection and overhead
SIR	-	Savings-to-Investment Ratio
SOW	-	scope of work
SPB	-	simple payback
UPW	-	Uniform Present Worth factor
yr	-	year(s)

EXECUTIVE SUMMARY

AUTHORIZATION FOR STUDY

This study was conducted and this report prepared under Contract No. DACA01-94-D-0033, Delivery Order No. 0007. The contract was issued by the U.S. Army Engineer District, Mobile, Alabama, to E M C Engineers, Inc. (EMC) on 15 August 1994.

PURPOSE OF STUDY

The purpose of this water conservation study is to conduct a limited site survey and evaluate energy use and savings, estimate construction costs and water savings and provide a cost-to-savings ratio associated with repairing the leaks in the domestic water distribution system at Ft. Richardson, Alaska.

METHOD OF ANALYSIS

Specific work required includes:

1. Perform a limited site survey of the potable water system to collect data required to evaluate specific energy conservation opportunities (ECOs).

2. Conduct a thorough survey of the potable water system using state-of-the-art underground leak detection equipment on all piping designated on site maps by Ft. Richardson personnel.

3. Evaluate specific ECOs to determine energy savings potential and economic feasibility associated with repairing leaks to the domestic water distribution system.

4. Provide programming documentation for recommended ECOs.

5. Prepare a report to document work performed, and to describe the results and recommendations of the site energy audit and the leak detection study.

LEAK DETECTION SURVEY

A leak detection survey was performed on all water distribution piping designated on Post site maps by Ft. Richardson personnel. The leak detection analysis was performed using a combination of listening devices and preamplified-transducer systems to identify the

majority of leak locations. When the location of the leak could not be readily identified using these methods, a leak correlator was used. The leak correlator determines leak location based on the time it takes for sound to travel from the leak to a waterline connection point.

Seventeen leaks were identified by the survey on the water mains within the project scope area. The estimated leakage of 238,000 gallons per day (gpd) was categorized into the following types of leaks:

- Five main line leaks at 216,000 gpd.
- Five valve leaks at 12,500 gpd.
- One service line leak at 3,500 gpd.
- Six fire hydrant leaks at 6,000 gpd.

ENERGY CONSERVATION OPPORTUNITIES

Approximately 15% of the water usage in the Ft. Richardson water distribution system can be attributed to leakage. ECOs were evaluated that would serve to reduce leakage, thereby reducing water production, maintenance, and energy costs.

Description of ECOs

Five ECOs were identified to reduce leakage in the process water system. These four ECOs are:

- **ECO 1.** Repair main line water leaks identified in leak detection survey. Five leaks, in pipes ranging in size from 4 to 14 inches in diameter, were identified.

- **ECO 2.** Repair water valve leaks identified in the leak detection survey. Several water valves, ranging in size from 4 to 10 inches, were found to have packing leaks and should be replaced.

- **ECO 3.** Repair fire hydrants which were found to be leaking during the leak detection survey. Six fire hydrants were found to be leaking and should be replaced.

- **ECO 4.** Repair the main line, water valve, and hydrant leaks identified above.

- **ECO 5.** Implement an annual water audit and leak detection program.

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- **ECO 5.** Implement an annual water audit and leak detection program.

Economic Analysis

The economic analysis of the ECOs is summarized in Table ES-1 below.

Table ES-1. Summary of ECOs

ECO No.	Description	Investment Cost ($)	Annual Water Savings*	Total Discounted Savings ($)	SIR	Payback (yrs)
1	Repair Main Line Leaks	7,820	78.840	840,164	107.44	0.14
2	Repair Valve Leaks	15,228	4.562	48,615	3.19	4.66
3	Repair Fire Hydrant Leaks	16,908	2.190	23,338	1.38	10.78
4	Repair All Leaks	39,955	85.593	912,122	22.83	0.65
5	Implement Leak Detection	23,800	49.384	526,264	22.11	0.67

*Annual Water Savings are in units of millions of gallons saved per year

ECOs 1, 2, 4, and 5 display favorable economic payback. That is, they all have SIRs greater than 1.25 and a simple payback of 10 years or less. Based on the qualifications listed by the Scope of Work, these ECOs qualify for government energy conservation funding programs. ECO 3 does not qualify.

RECOMMENDATIONS

The ECOs listed in Table ES-2 below are recommended for implementation:

Table ES-2. Recommended ECOs

ECO No.	Description	Investment Cost ($)	Annual Water Savings*	Total Discounted Savings ($)	SIR	Payback (yrs)
4	Repair All Leaks	39,955	85.593	912,122	22.83	0.65
5	Implement Leak Detection	23,800	49.384	526,264	22.11	0.67

*Annual Water Savings are in units of millions of gallons saved per year

- **ECO 4.** Replace all main line, valves, and hydrant leaks identified by the leak detection survey.

- **ECO 5.** Implement a leak detection program, including a water audit, every year as recommended by AWWA Manual 36. Implement a policy to immediately excavate and repair all leaks discovered by the leak detection survey.

1. INTRODUCTION

1.1 AUTHORITY FOR STUDY

This study was conducted and this report prepared under Contract No. DACA01-94-D-0033, Delivery Order No. 0007. The contract was issued by the U.S. Army Engineer District, Mobile, Alabama, to E M C Engineers, Inc. (EMC).

1.2 PURPOSE OF STUDY

The purpose of this water conservation study is to:

- Conduct a limited site survey.
- Evaluate energy use and savings.
- Estimate construction costs and water savings.
- Provide a cost to savings ratio associated with repairing leaks to the domestic water distribution system at Ft. Richardson, Alaska.

The study will present information obtained during an audit and leak detection study of the water distribution system. The study will also make recommendations for corrective actions that could result in energy, operational and maintenance savings. Recommendations presented by this study are based strictly on economic feasibility and life cycle cost analysis.

1.3 BACKGROUND

Ft. Richardson is located just northeast of downtown Anchorage, Alaska. The objective of Ft. Richardson is described in its mission statement:

> *Command and control U.S. Army Forces in Alaska. Provide the services, facilities, and infrastructure to support power projection and training to rapidly deploy U.S. Army Forces from Alaska in the conduct of contingency operations within the Pacific theater and elsewhere as directed.*

A copy of the mission statement for Ft. Richardson is included in Appendix A.

Ft. Richardson collects and stores water from Ship Creek Canyon Dam. The reservoir serves as the primary source of water for the military as well as the City of Anchorage. Ft. Richardson operates a water treatment plant to treat the water taken from the reservoir. The water supply to Anchorage is diverted prior to the water treatment facility and is not treated by Ft. Richardson. The water treatment plant at Ft. Richardson supplies both Ft. Richardson and Elmendorf Air Force Base (AFB) with potable water. Water is gravity fed

from the reservoir to the treatment plant. The only pumps at the plant are used to backwash the filters.

Ft. Richardson is served by a multi-looped water distribution system. Potable water is distributed throughout the base by approximately 85 miles of piping. The distribution system, which is generally 25-40 years old, consists mainly of asbestos cement and cast iron piping. There are small amounts of PVC piping on Post. Service and lateral lines are generally constructed of steel pipe.

1.4 SCOPE OF WORK

The Scope of Work (SOW) for this project is included in Appendix A of this report. The major technical criteria identified by the SOW are:

- Perform a limited site survey on Ft. Richardson's water distribution system. Sufficient information should be collected to allow for an adequate understanding of the water system and to identify possible ECOs as they are associated with repairing leaks to the domestic water distribution system. This information would include as-built drawings, historical usage data, and interviews of on-site personnel.

- Perform an underground leak detection survey on all piping designated on site maps by Ft. Richardson personnel. The survey should identify the location, type and quantity of all discovered leaks.

- Evaluate identified ECOs to determine their energy savings potential and economic feasibility.

- Provide programming documentation for recommended ECOs.

- Prepare a report to document work performed and to describe the results and recommendations of the site and energy audit and the leak detection study.

1.5 APPROACH

The approach taken in this study is as follows:

1. **Field Survey.** The water distribution system at Ft. Richardson was examined to gain an understanding of system operation and maintenance and to determine the condition of the system. Information such as pump nameplate data, as-built drawings, and historical meter data was obtained. On-site personnel were interviewed to ascertain system operation and to define unacceptable conditions, past problems, and future requirements.

2. **Leak Detection Survey.** A survey of all water distribution piping designated on site maps by Ft. Richardson personnel was performed to determine the location, type, and quantity of leaks.

3. **Analysis of Leak Detection Survey.** Data from the leak detection survey was summarized. The location of each leak was documented on individual drawings and the quantities of the leaks were tabulated in a separate table.

4. **ECO Analysis.** Appropriate ECOs were identified and analyzed to determine their economic feasibility. Economic feasibility was judged as a comparison between the investment cost of implementing the ECO and the savings that would result. Cost savings were calculated as the sum of reduced pumping, water treatment, and maintenance costs as a result of reduced water consumption. Criteria outlined by the Energy Conservation Investment Program (ECIP) was used to define economic feasibility. A recommended ECO must have a savings-to-investment ratio (SIR) of 1.25 or better and a simple payback (SPB) of 10 years or less to be considered.

5. **Interim Report and Review.** The results of the field and leak detection survey, as well as the identification and analysis of ECOs, are to be presented in the interim report. The ECOs are to be organized as possible ECIP or Federal Energy Management Program (FEMP) projects.

6. **Final Report.** The results of the governmental review will be incorporated into the Final Report. Additionally, the incorporation of programming documentation, and the interim report constitute the final report. The programming documentation has been prepared according to direction given by the client, based on recommendations outlined by the interim report.

2. DESCRIPTION OF EXISTING CONDITIONS

2.1 GENERAL

During the week of 29 May 1995, a field survey was performed by EMC to obtain the necessary information to identify and evaluate possible energy conservation opportunities (ECOs) for the potable water distribution system at Ft. Richardson as they are associated with repairing leaks to the domestic water distribution system. It was determined that approximately 15% of the water consumption is due to leaks in distribution piping, valves, and fire hydrants. Therefore, the ECOs would seek to reduce water usage by reducing the amount of leakage.

2.1.1 Description of Water Distribution System

Ft. Richardson collects and stores water from Ship Creek Canyon Dam. The reservoir serves as the primary source of water for the military as well as the City of Anchorage. The dam provides a minimum storage of 10 million gallons for Ft. Richardson, Elmendorf AFB, and the City of Anchorage. The water supply to Anchorage is diverted prior to the water treatment facility and is not treated by Ft. Richardson. The annual operating hours of the auxiliary pumps were based on pump schedules given by Ft. Richardson personnel.

Water is gravity fed from the reservoir to the treatment plant at Ft. Richardson which supplies both Ft. Richardson and Elmendorf Air Force Base (AFB) with potable water. The Ft. Richardson water treatment plant was constructed in 1952 and expanded in 1957. It consists of four flocculation and sedimentation basins, eight sand filters, and a clearwell storage. The plant provides flocculation, chemical treatment, and disinfection for a design production of 7 million gallons per day. The plant provides both Ft. Richardson and Elmendorf AFB with potable water.

Three auxiliary water wells, with a total design capacity of 2,700 gpm, are operated and maintained to supplement the surface water supply. In general, these wells are a supply source for the Alaska Department of Fish and Game and is infrequently used by Ft. Richardson.

Ft. Richardson is served by a multi-looped water distribution system. Potable water is distributed throughout the base by approximately 85 miles of piping. The distribution system, which is generally 25-40 years old, consists mainly of asbestos cement and cast iron piping. There are small amounts of PVC piping on the Post. Service and lateral lines are constructed mostly of steel piping. System pressures are maintained at approximately 55 to 90 psig.

A 2.5 million gallon treated water storage reservoir is located north of the Circle Drive area at Ft. Richardson to supplement system capacity during peak flows and for fireflows. A

pump is located at the reservoir and is required to operate to overcome water head pressure from the water treatment plant when supplemental flow is required.

Ft. Richardson also has two other pump stations which are occasionally used to circulate water in the distribution system. Table 2-1 describes the size, location and purpose for these supplementary pumps, including the reservoir pump. The annual operating hours of the auxiliary pumps were based on pump schedules provided by Ft. Richardson personnel.

Table 2-1. Auxiliary Pump System

Location	Motor Manufacturer	Motor Size (hp)	Purpose of Pump	Annual Operating Hours
Davis Hwy Pump Station	Baldor	7.5	Provides irrigation to cemetary, armory	4,380
Water Circ. Pump Station	US Motor	20	Circulates water along Circle Drive for freeze protection	5,125
Reservoir Pump	US Motor	30	Overcomes head pressure to reservoir	1,100

Historical water usage was taken from operating logs from the water treatment plant. The quantity of water used by Elmendorf AFB was determined from a seven year average water meter reading for each particular month. Water production and maintenance cost figures were furnished for the period of FY1994 (From October 1993 to September 1994). Table 2-2 summarizes the total water usage for Ft. Richardson and Elmendorf AFB for that time period.

Table 2-2. Water Usage FY1994

	Water Quantity (kgal)
Total Quantity Produced	1,554,818
System Loss (5%)	(77,741)
Subtotal	1,477,077
Furnished to Elemendorf	929,615
Total-Ft. Richardson	547,462

A detailed summary of monthly water usage as well as usage data supplied by Ft. Richardson can be found in Appendix B.

2.2 LEAK DETECTION SURVEY

A leak detection survey was performed on water distribution piping designated on site maps by Ft. Richardson personnel to determine the location, type, and quantity of leaks. By direction of Ft. Richardson personnel, 55 miles of pipe were surveyed for leaks out of a total

of 86 miles of water distribution piping. M.E. Simpson (MES) of Valparaiso, Indiana, was contracted by EMC to perform the leak detection analysis.

2.2.1 Method of Analysis

When water escapes from an orifice, it causes a vibration in the 500-800 Hz range. This sound travels along the pipe wall and can be heard a considerable distance away by an observer with the proper equipment. Other sounds (in the 25-250 Hz range) are caused by water striking the soil and swirling around in the cavity it creates. This sound does not travel well along the pipe, and is therefore useful in pinpointing the leak. (Walski, 1984)

Leak detection by listening is qualitative, as there is virtually no correlation between size of leak and intensity of sound. The sound is influenced by such factors as pipe material (metal pipes conduct sound better), soil type, and leak configuration. (Walski, 1984)

MES used a combination of listening devices and preamplified-transducer systems to identify the majority of leak locations during the leak detection survey. When identification of the leaks proved difficult by these means, they used a device called a leak correlator to identify the leak location.

The correlator is used when the leak location(s) are not readily identified by the above methods. The correlator is connected to the waterline at two points. The microprocessor units measure the time it takes for the sound to travel from the leak to the waterline connection point. Since the correlators are connected to the waterline at two points, the precise leak location can be identified.

Using the listening devices and transducers set up on fire hydrants and valve boxes when appropriate, MES "listened" for leaks in the system. The audible noises created when water escapes from a pipe, valve, or hydrant can be deciphered as the source of the leak.

Water flowing through the pipe at the point of use creates similar sounds to water leakage. MES eliminated these water usage sounds from consideration by investigating the general area to locate any normal water usage. If usage was found in the general area, the water supply would have been turned off and the water line retested. If no usage was found in the general area, the sounds would have been attributed to leakage. MES did not have to turn off any water supplies during this survey at Ft. Richardson.

When MES located the source of a leak noise, they initially called in an excavating crew to excavate the leak. Once uncovered, the leak rate was estimated by the "bucket and stopwatch method" or by using the experience of the technician. As the leak detection survey progressed through the Post, an excavating crew was not called in for every leak found. The location and size of the leaks were located and noted on a map (enclosed in the pocket). In addition to the "bucket and stopwatch method", the Greeley formula and the "hose and meter" method were also used. These and other methods used are described in AWWA M36.

2.2.2 Summary of Results

The water mains within the project scope area were surveyed and seventeen leaks were located. The total leakage quantity was estimated to be 238,000 gallons per day (86,879,000 gallons per year. This translates to approximately 15% of the total water usage at Ft. Richardson (see Table 2-2). The leakage quantity is made up of:

- Five main line leaks at 216,000 gpd.
- Five valve leaks at 12,500 gpd.
- One service line leak at 3,500 gpd.
- Six fire hydrant leaks at 6,000 gpd

A breakdown of the leakage results and locations of the leaks is contained in Appendix C.

3. WATER SYSTEM ENERGY AUDIT

The cost of water at Ft. Richardson varies with the amount of water produced. Reducing the amount of water lost to leakage can result in energy and cost savings. The total cost of water can be separated into the following categories:

- **Water Production Costs.** Water production costs consist of the material costs to operate the water treatment plant, including supplies and equipment costs. This would include the costs for chemical treatment.

- **Maintenance Costs.** These costs include the labor costs associated with operating and maintaining the water distribution system and the water treatment plant.

- **Pump Electrical Consumption.** Three 50 hp backwash pumps operate at the water treatment plant. In addition, three pumps are used periodically throughout the year to circulate water through the distribution system and to supplement water flow. Reducing water leakage in the distribution system will decrease the amount of electrical consumption required by these pumps.

The purpose of this energy audit is to investigate possible energy conservation opportunities (ECOs) that would serve to reduce leakage in the distribution system. The energy audit is based on information from two sources, a leak detection survey and a water audit. The leak detection survey was conducted to assess the current quantity of water lost to leakage in main lines, valves, and hydrants. Energy and cost savings will be produced by reducing the amount of leakage. These savings are described in ECOs 1 through 4. The water audit performed in this study estimates potential leakage in the distribution system and is the basis for calculation of ECO 5.

3.1 ENERGY AND MAINTENANCE COSTS

Projects that are analyzed using the Energy Conservation Investment Program (ECIP) criteria must differentiate between energy and non-energy savings because different discount rates apply to each. Therefore, electrical, maintenance, and water production cost savings were calculated separately in units of cost per gallon of leakage saved.

Energy and maintenance costs of the water distribution system are related to the total amount of potable water distributed at Ft. Richardson. Therefore, it is possible to translate leakage savings directly into cost savings.

According to data provided by Ft. Richardson (dated 27 March 1995), for the period from October 1993 to September 1994, the cost of water was calculated as:

- **Water Production Costs: $0.4047 per kgal.** For the total quantity of water produced (1,477,077 kgal), the total cost of production was $597,790.

- **Maintenance Costs: $0.3064 per kgal.** For the total quantity of water produced (1,477,077 kgal), the cost for maintenance was $452,556.

- **Pump Electrical Consumption: $0.005 per kgal.** This value was calculated by taking the total annual energy consumption for these pumps divided by the total annual water consumption. Annual energy consumption was calculated based on pump operating schedules and electrical rate data provided by Ft. Richardson personnel. During this period, the total cost of operating the backwash pumps was $586, and $6,800 for the three circulating pumps. The electrical operating cost for the circulating pumps was calculated using the following equation:

$$Consumption\ (kWh) = \frac{(HP)(0.746)(LF)(Hours)}{EFFM}$$

where

HP	=	nameplate horsepower,
0.746	=	conversion factor relating kilowatts to horsepower,
LF	=	load factor (assume 75% average),
EFFM	=	motor efficiency, and
Hours	=	annual operating hours

A copy of the cost calculations and water cost figures provided by Ft. Richardson can be found in Appendix D.

3.2 LIFE CYCLE COST ANALYSIS METHODOLOGY

Economic analysis was performed in accordance to the January 1994 ECIP guide. Uniform present worth factors are based on a 3.0% discount factor and were taken from Table 2, Census Region 4 (Alaska), of the NISTIR 85-3273-9, *Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis (Oct. 1994).* Uniform present worth (UPW) factors for non-energy costs were taken from Table A-2. The economic life of equipment was taken from Appendix B of the ECIP guide. A copy of the life cycle discount factors can be found in Appendix D.

ECO construction costs were prepared using the Micro Computer Aided Cost Engineering System (MCACES-Gold), version 5.30 provided by Ft. Richardson. Material and labor costs were taken from the 1994 Unit Price and Labor Cost database for Anchorage, Alaska. Additional markups used for the LCCA include:

- 15% for overhead
- 1.5% for bond
- 10% for profit
- 10% for contingency
- 6% for Supervision, Inspection, and Overhead (SIOH)
- 6% for design costs

3.3 ENERGY CONSERVATION OPPORTUNITIES

The following ECOs were evaluated for the potable water distribution system:

- **ECO 1.** Repair main line water leaks identified in leak detection survey. Five leaks, in pipes ranging in size from 4 to 14 inches in diameter, were identified.

- **ECO 2.** Repair water valve leaks identified in the leak detection survey. Five water valves, ranging in size from 4 to 10 inches, were found to have packing leaks and should be replaced.

- **ECO 3.** Repair fire hydrants which were found to be leaking during the leak detection survey. Six fire hydrants were found to be leaking and should be replaced.

- **ECO 4.** Repair the main line, valve and fire hydrant leaks.

- **ECO 5.** Implement an annual water audit and leak detection program.

3.3.1 ECO 1: Repair Main Line Leaks

Proposed Modifications: Repair main line water leaks identified in leak detection survey.

Existing Conditions: The leak detection survey located five main line leaks in the water distribution system. The total leakage quantity was estimated at 216,000 gpd. The complete leak detection report can be found in Appendix C.

Method of Analysis: Analysis proceeded as follows:

- The total quantity of all main line leaks located by the leak detection survey was summarized and located on site location maps.

- Cost estimates were performed to determine the cost of repairing these pipes. Costs for site work were included with the costs for patching the leaks.

- A Life Cycle Cost Analysis (LCCA) was performed to determine the life cycle cost of repairing the leaks located by the leak detection survey. **Note: The leak detection survey was performed in June 1995. It is possible that new leaks have occurred in the interim while some of the old leaks may have been repaired. The economic analysis is strictly based on the leakage quantities identified by the leak detection survey.**

Results: Table 3-1 below summarizes the economic analysis. The LCCA, cost estimate, and calculation of total leakage savings can be found in Appendix D.

Table 3-1. ECO 1 Economic Analysis

Total Investment	$7,820
Annual Water Savings (kgal/year)	78,840
Annual Cost Savings	$56,457
Total Discounted Cost Savings	$840,164
Simple Payback (years)	0.14
Savings-to Investment Ratio	107.44

ECIP funding qualifications require an ECO candidate to have a simple payback of 10 years or less and an SIR of 1.25 or better. This ECO meets government funding criteria.

It is important to note that some of the main line leaks may have been repaired by maintenance personnel at the time they were discovered by the leak detection survey. Coordination with maintenance personnel will be necessary to determine which leaks are still in need of repair.

3.3.2 ECO 2: Repair Water Valve Leaks

Proposed Modifications: Repair water valve leaks identified in leak detection survey.

Existing Conditions: The leak detection survey identified five water valve leaks. The total leakage quantity was estimated at 12,500 gpd. The complete leak detection report can be found in Appendix C.

Method of Analysis: Analysis proceeded as follows:

- The total quantity of all water valve leaks located by the leak detection survey was summarized and located on site location maps.
- Cost estimates were performed to determine the cost of replacing these valves. Costs for site work were included with the costs for replacing the valves.
- A Life Cycle Cost Analysis (LCCA) was performed to determine the life cycle cost of repairing the leaks located by the leak detection survey. **Note: The leak detection survey was performed in June 1995. It is possible that new leaks have occurred in the interim while some of the old leaks may have been repaired. The economic analysis is be strictly based on the leakage quantities identified by the leak detection survey.**

Results: Table 3-2 below summarizes the economic analysis. The LCCA, cost estimate, and calculation of total leakage savings can be found in Appendix D.

Table 3-2. ECO 2 Economic Analysis

Total Investment	$15,228
Annual Water Savings (kgal/year)	4,562
Annual Cost Savings	$3,267
Total Discounted Cost Savings	$48,615
Simple Payback (years)	4.66
Savings-to Investment Ratio	3.19

ECIP funding qualifications require an ECO candidate to have a simple payback of 10 years or less and an SIR of 1.25 or better. This ECO meets government funding criteria.

It is important to note that some of the main line leaks may have been repaired by maintenance personnel at the time they were discovered by the leak detection survey. Coordination with maintenance personnel will be necessary to determine which leaks are still in need of repair.

3.3.3 ECO 3: Repair Fire Hydrant Leaks

Proposed Modifications: Repair fire hydrant leaks identified in leak detection survey.

Existing Conditions: The leak detection survey located six fire hydrant leaks. The total leakage quantity was estimated at 6,000 gpd. The complete leak detection report can be found in Appendix C.

Method of Analysis: Analysis proceeded as follows:

- The total quantity of all fire hydrant leaks located by the leak detection survey was summarized and located on site location maps.

- Cost estimates were performed to determine the cost of replacing the leaking fire hydrants. Costs for site work were included with the costs for replacing the hydrants.

- A Life Cycle Cost Analysis (LCCA) was performed to determine the life cycle cost of repairing the leaks located by the leak detection survey. **Note: The leak detection survey was performed in June 1995. It is possible that new leaks have occurred in the interim while some of the old leaks may have been repaired. The economic analysis is strictly based on the leakage quantities identified by the leak detection survey.**

Results: Table 3-3 summarizes the economic analysis. The LCCA, cost estimate, and calculation of total leakage savings can be found in Appendix D.

Table 3-3. ECO 3 Economic Analysis

Total Investment	$16,908
Annual Water Savings (kgal/year)	2,190
Annual Cost Savings	$1,568
Total Discounted Cost Savings	$23,338
Simple Payback (years)	10.78
Savings-to Investment Ratio	1.38

ECIP funding qualifications require an ECO candidate to have a simple payback of 10 years or less and an SIR of 1.25 or better. This ECO does not meet government funding criteria.

3.3.4 ECO 4: Repair Main Line, Valve, and Fire Hydrant Leaks

Proposed Modifications: Repair all leaks identified in leak detection survey.

Existing Conditions: The leak detection survey located five main line leaks, five valve leaks, and six fire hydrant leaks. The total leakage quantity was estimated at 234,500 gpd. The complete leak detection report can be found in Appendix C.

It was assumed that the service line leak, which was located inside an inaccessible building, was a water faucet that was left open to protect the water distribution system from freezing, not a leak. Therefore, its estimated leakage value of 3,500 gpd was not included in this ECO.

Method of Analysis: Analysis proceeded as follows:

- The total quantity of all leaks located by the leak detection survey was summarized and located on site location maps.
- Cost estimates were performed to determine the cost of repairing the leaks. Costs for site work were included with the repair costs.
- A Life Cycle Cost Analysis (LCCA) was performed to determine the life cycle cost of repairing the leaks located by the leak detection survey. **Note: The leak detection survey was performed in June 1995. It is possible that new leaks have occurred in the interim while some of the old leaks may have been repaired. The economic analysis is strictly based on the leakage quantities identified by the leak detection survey.**

Results: Table 3-4 below summarizes the economic analysis. The LCCA, cost estimate, and calculation of total leakage savings can be found in Appendix D.

Table 3-4. ECO 4 Economic Analysis

Total Investment	$39,955
Annual Water Savings (kgal/year)	85,593
Annual Cost Savings	$61,293
Total Discounted Cost Savings	$912,122
Simple Payback (years)	0.65
Savings-to Investment Ratio	22.83

ECIP funding qualifications require an ECO candidate to have a simple payback of 10 years or less and an SIR of 1.25 or better. This ECO meets government funding criteria.

3.3.5 ECO 5: Implement Leak Detection Program

Proposed Modifications: Implement a water audit followed by a leak detection program on an annual basis. This audit is based upon actual and theoretical water consumption values and is used to establish a baseline (minimum value) of expected water leakage rate. When the actual values of water consumption are well known, thereby reducing the number of theoretical values, the amount of recoverable water distribution system leakage can be readily and accurately identified.

Existing Conditions: A water audit was performed on the potable water system according to guidelines set by the American Water Works Association (AWWA) Manual 36, "Water Audits and Leak Detection." The audit was based on information supplied by Ft. Richardson. Water usage in the potable water system can be separated into the following categories:

- **Domestic Water Consumption.** The amount of water consumed by all military and civilian occupants of Ft. Richardson was estimated. Population demographic data, obtained from Ft. Richardson, presents a detailed count of the number of people who occupy the base. These demographics, taken from the U.S. Army Alaska Installation Population Profile (December 1994), were separated into military and civilian personnel, family members, retirees, and on- and off-post residents.

  According to guidelines in Army Technical Manual TM 5-813-1, "Water Supply Sources and General Considerations," the design allowances for water consumption are 150 gpd per person for residents and 50 gpd per person for non-residents. Multiplying these design allowances by the number of residents and non-residents produces an estimate of the amount of water consumed for domestic use.

- **Fire Hydrants**. There are approximately 421 hydrants that serve Ft. Richardson. These hydrants are tested on a regular basis. Results of fire hydrant testing for the last two years was obtained from Ft. Richardson. It was assumed that each hydrant was tested for approximately five minutes at the flow rate listed in the test results.

The product of the hydrant flow rate and test length was calculated to be the total water usage per year.

- **Industrial Uses.** Potable water is used as makeup water to the electrical and steam plants. The quantity of water used by each plant was provided by Ft. Richardson.

- **Street Cleaning.** Conversations with Ft. Richardson personnel revealed that the Roads and Grounds Department uses potable water to wash streets. The amount of water used was estimated by Ft. Richardson to be approximately 1,800,000 gallons per year.

- **Irrigation Water.** From mid-May to September, water from the distribution system is used to irrigate the golf course, cemetery, and athletic fields at Ft. Richardson. These areas are supplied by three 2-1/2 inch and three 4 inch diameter water lines, which produce an estimated 800 gpm. It was assumed that the full capacity of the water lines feeding these areas is used for approximately four hours per day.

- **Discovered leaks.** Ft. Richardson has maintained a record of the water line breaks that have been repaired. The amount of water that is annually lost through these line breaks was estimated. During the summer of 1994, six water line breaks were repaired on pipe lines ranging in size from 6 to 20 inches. Assumptions were made for the amount of water lost (gpm) and the number of days required to discover and repair the leaks.

Table 3-5 summarizes the results of the water audit of the potable water system.

Table 3-5. Water Audit Results

Potable Water Uses	Gallons Per Year
Total Water Produced*	**547,462,000**
Domestic Water Consumption	414,558,800
Fire Hydrants	789,470
Industrial Uses	
Electric Plant	11,564,000
Steam Plant	14,745,000
Street Cleaning	1,800,000
Irrigation	23,040,000
Discovered leakage	15,120,000
Total Identified Water Consumed	**481,617,270**
Potential Water System Losses	**65,844,730**
Recoverable Leakage	**49,383,550**

*Total Water Produced= Total Amount Produced - System Losses (5% of Total) - Elmendorf Usage

Method of Analysis: Analysis proceeded as follows:

- A water audit was performed on the potable water system according to AWWA Manual 36. All water usage in the audit was based on information obtained from Ft. Richardson personnel.

- The amount of recoverable leakage was estimated. According to AWWA Manual 36, recoverable leakage is defined as approximately 75% of all potential losses in the system. For this audit, it was assumed that all potential losses, which are equal to the total water produced minus the total identified water consumed, outlined in Table 3-5, can be fully attributed to potential leakage.

- The total beneficial cost of repairing recoverable leakage was calculated. The cost of water was assumed to be the costs that vary with the amount of water delivered to the potable water system. These include production, maintenance, and energy costs. The cost of leak repair, however, is not included. Because leaks are continually discovered and repaired in the normal course of operations, the leaks found in the leak detection program would eventually be repaired (AWWA Manual 36). If the leaks are repaired as part of a leak detection program, as is Ft. Richardson's policy, the expense of repairing leaks as they are accidentally discovered is avoided. Although some cost savings would be realized in fixing the leaks when they are discovered by a leak detection program, as opposed to discovering them accidentally, AWWA Manual 36 allows the auditor to assume that the savings is negligible.

- The total payback of the leak detection program was calculated by dividing the total cost of the leak detection program by the cost savings of recovered leakage. The total cost of the leak detection survey was taken from cost information provided by AWWA and from the average cost of the contractor's bids for the leak detection survey performed at Ft. Richardson. Approximately 85 miles of pipe would need to be investigated according to Ft. Richardson personnel. Thus, the cost of a leak detection survey was calculated to be $250 per mile of pipe surveyed.

Results: The water audit estimated that 14% of the Ft. Richardson water production is attributable to water lost due to leakage, and 9% is recoverable. Table 3-6 below summarizes the results of the economic analysis. The LCCA and water audit worksheets can be found in Appendix D.

Table 3-6. ECO 5 Economic Analysis

Amount of Recoverable Leakage (gal/yr)	49,383,550
Cost of Potable Water (per 1000 gal)	$0.7161
Total Cost of Leak Detection Program	$23,800
Annual Cost Savings	$35,364
Total Discounted Cost Savings	$526,264
Simple Payback (years)	0.67
Savings-to-Investment Ratio	22.11

ECIP funding qualifications require an ECO candidate to have a simple payback of 10 years or less and a savings-to-investment ratio (SIR) of 1.25 or better. Therefore, this ECO meets government funding criteria.

4. SUMMARY AND RECOMMENDATIONS

4.1 SUMMARY OF THE WATER DISTRIBUTION SYSTEM

According to the data accumulated from the field survey and the leak detection survey, the following were noted:

- The potable water system at Ft. Richardson uses an average of 547,462,000 gallons of water per year, which translates to a daily rate of almost 1.5 million gallons.
- The estimated leakage discovered by the leak detection survey was 236,000 gpd (86,870,000 gallons per year), or just over 15% of the total usage.
- The estimated audit value for annual recoverable leakage was calculated to be 49,383,550 gallons per year, or nearly 9% of the total usage.

The estimated audit value is a baseline or "minimum expected" leakage rate. The estimated leakage discovered is the actual estimated leakage rate. Given this information, it should be noted that the results of ECO 5 show a favorable economic payback while using the lower leakage amount of the water audit.

4.2 SUMMARY OF ENERGY AUDIT

According to the Scope of Work, ECIP criteria is to be used to categorize ECOs. In order to qualify for government funding programs, the ECOs must have a simple payback of 10 years or less and a SIR of 1.25 or greater. For this study, five ECOs were investigated. Table 4-1 summarizes the ECOs investigated in this study.

Table 4-1. Summary of ECOs

ECO No.	Description	Investment Cost ($)	Annual Water Savings*	Total Discounted Savings ($)	SIR	Payback (yrs)
1	Repair Main Line Leaks	7,820	78.840	840,164	107.44	0.14
2	Repair Valve Leaks	15,228	4.562	48,615	3.19	4.66
3	Repair Fire Hydrant Leaks	16,908	2.190	23,338	1.38	10.78
4	Repair All Leaks	39,955	85.593	912,122	22.83	0.65
5	Implement Leak Detection	23,800	49.384	526,264	22.11	0.67

*Annual Water Savings are in units of millions of gallons saved per year

4.3 RECOMMENDATIONS

It is recommended that the qualifying ECOs for government funding programs be implemented. A summary of the recommended is listed in Table 4-2 below.

Table 4-2. Recommended ECOs

ECO No.	Description	Investment Cost ($)	Annual Water Savings*	Total Discounted Savings ($)	SIR	Payback (yrs)
4	Repair All Leaks	39,955	85.593	912,122	22.83	0.65
5	Implement Leak Detection	23,800	49.384	526,264	22.11	0.67

*Annual Water Savings are in units of millions of gallons saved per year

- **ECO 4.** Replace the main line, valves, and fire hydrants identified as having leaks by the leak detection survey. Note that some of the main line leaks may have been repaired by maintenance personnel at the time they were discovered by the leak detection survey. Coordination with maintenance personnel will be required to determine which leaks are still in need of repair.

- **ECO 5.** According to the guidelines set by AWWA Manual 36, a leak detection survey should be performed annually. An aggressive leak detection program, which would include a water audit, should produce a decrease in the amount of leakage. The water audit showed that the benefits of performing a leak detection survey and repairing the leaks that are discovered will outweigh the costs of the survey.

5. REFERENCES

AWWA Manual 36, Water Audits and Leak Detection, American Water Works Association, Denver, CO, 1990.

AWWA Research Foundation, Assessment of Existing and Development of Water Main Rehabilitation Practices, American Water Works Association, Denver, CO, 1990.

AWWA Research Foundation, Water Main Evaluation for Rehabilitation/Replacement, American Water Works Association, Denver, CO, 1986.

Walski, Thomas M., Ph.D., P.E., Analysis of Water Distribution Systems, Van Nostrand Reinhold Company Inc., 1984.

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APPENDIX A

SCOPE OF WORK AND CONFIRMATION NOTICES

Scope of Work
Confirmation Notices
Ft. Richardson Mission Statement

APPENDIX "A"

GENERAL SCOPE OF WORK
CONTRACT NO. DACA01-94-D-0033
Delivery Order No. 0007
WATER CONSERVATION STUDY
FORT RICHARDSON, ALASKA
performed as part of the
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

TABLE OF CONTENTS

ANNEXES

1.0 BRIEF DESCRIPTION OF WORK: The Architect-Engineer (A/E) shall:

1.1. Perform a limited site survey of specific buildings or areas collect all data required to evaluate the specific ECOs included in this study.

1.2. Provide project documentation for recommended ECOs as detailed herein.

1.3. Prepare a comprehensive report to document all work performed, the results, and all recommendations.

2.0 GENERAL:

2.1. For the purposes of this scope of work, ECOs (Energy Conservation Opportunity) are defined as either water or energy conservation opportunities.

2.2. This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.

2.3. The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.

2.4. For the buildings, systems, or ECOs listed in Annex A, all methods of energy or water conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All ECOs which produce water, energy, or dollar savings shall be documented in this report. Any ECO considered infeasible shall also be documented in the report with reasons for elimination.

2.5. The study shall consider the use of all energy sources applicable to each building, system, or ECO.

2.6. The "Energy Conservation Investment Program (ECIP) Guidance" establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. A computer program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. This program is available commercially from the BLAST Support Office in Urbanna, Illinois. The BLAST Support Office can be contacted at 1-800-842-5278. The latest version of the program should be used. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval prior to use.

2.7. ECOs determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or MCA funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.

3.0 PROJECT MANAGEMENT:

3.1. Project Managers:

3.1.1 Project Manager: The A/E shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. This designated individual shall be responsible for coordination of work required under this contract.

3.1.2 Design Manager: The Contracting Officer will designate a design manager to serve as the Government's point of contact and liaison for all work required under this contract.

3.2. Installation Assistance: The Director of Public Works or authorized representative will designate an individual to assist the A/E in obtaining information and establishing contacts necessary to accomplish the work required under this contract.

3.3. Public Disclosures: The A/E shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4. Meetings: Meetings will be scheduled whenever requested by the A/E or the Design Manager for the resolution of questions or problems encountered in the performance of the work. The A/E's project manager and the design manager shall be required to attend and participate in all meetings pertinent to the work required under this contract. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5. Site Visits, Inspections, and Investigations: The A/E shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6. Conferences and Confirmation Notices:

3.6.1. The A/E shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the A/E and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The A/E shall forward to the Design Manager within ten calendar days, a reproducible copy of the records.

3.6.2. The A/E shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The A/E shall forward to the Design Manager within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.6.3. A review conference will be scheduled approximately 28 days after submittals. Review comments will be provided at this conference. These comments will become part of the

conference minutes forwarded to the A-E and annotated with conference action. Review comments provided to the A-E will not necessarily show coordination requirements with other parts of the submittal. The A-E shall incorporate the review comments into each part of the submittal as necessary.

3.7. Interview: The A/E shall conduct entry and exit interviews with the Director of Public Works or designated representative before starting work at the installation and after completion of the field work. The Design Manager shall schedule the interviews at least one week in advance and shall be in attendance.

3.7.1. Entry: The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules
b. Names of energy analysts who will be conducting the site survey.
c. Proposed working hours.
d. Support requirements from the Directorate of Public Works.

3.7.2. Exit: The exit interview shall be conducted when the field work is complete and briefly describe the items surveyed and probable areas of energy conservation.

4.0 SERVICES AND MATERIALS: All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, supervision and travel necessary to perform the work and render the data required under this contact are included in the lump sum price of the contract.

5.0 PROJECT DOCUMENTATION: All energy conservation opportunities which the A/E has considered shall be included in one of the following categories and presented in the report as such:

5.1. ECIP Projects: To qualify as an ECIP Project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $300,000. The overall project and each discrete part of the project shall have an SIR greater than 1.25. Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Saving to Investment Ratio (SIR). Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented), and a Project Development Brochure (PDB). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs.

5.2. NON-ECIP Projects: Projects which do not meet ECIP criteria, but which have an SIR greater than 1.25 shall be documented and ranked in order of highest to lowest SIR. Projects or ECOs shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out; a description of the work to be accomplished; backup data for the LCCA, ie: energy savings calculations and cost estimate(s); and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account there synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation

prepared, as required by the Government's representative, for one of the following categories:

a. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $300,000 and a simple payback period of ten to twenty-five years. Documentation shall consist of DD Form 1391 and a Project Development Brochure.

b. Low Cost/No Cost Projects. These are projects which the Directorate of Public Works (DPW) can perform using its resources. Documentation shall be as required by DPW.

5.3 Nonfeasible ECOs: All ECOs which the A/E has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6.0 DETAILED SCOPE OF WORK: The Detailed Scope of Work is contained in Annex A.

7.0 WORK TO BE ACCOMPLISHED:

7.1. Review Previous Studies: Not Used.

7.2. Perform a Limited Site Survey: The A/E shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. The A/E shall document his site survey on forms developed for the survey, or on standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3. Revaluate Selected Projects: Not used.

7.4. Evaluate Selected ECOs: As described in Detailed Scope of Work.

7.5. Combine ECOs into Recommended Projects: At the interim review conference, the A/E will be provided direction for packaging or combining ECos for programming purposes and also will be provided the fiscal year for which the programming or implementation documentation shall be prepared. Some projects may be a combination of several ECOs, and others may contain only one.

7.6. Submittals: The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included.

7.6.1. Interim Submittal: An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken, and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly

marked at the time of sub ssion that they are to be retained. T' shall be bound separately in a standard three-ring binder. The A/E shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly.

7.6.2. Final Submittal: The A/E shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The A/E shall submit the Scope of Work for the study and any modifications to the scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

1) Energy cost development and backup data
2) Detailed calculations
3) Cost estimates
4) Computer printouts (where applicable)
5) Scope of Work

7.7 Presentation: The A/E shall give a formal presentation of the interim submittal to the installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. The presentation will be conducted the same day as the review conference.

SCOPE OF WORK AUGUST 1 0 1994
ANNEX A
Water Conservation Study
Fort Richardson, Alaska
CONTRACT NO. DACA01-94-D-0033
Delivery Order No. 0007

1.0 General Information:

1.1 The Architect-Engineer (A-E) shall furnish all services, materials, supplies, labor, equipment, investigations, studies, supervision, and travel as required in connection with this Statement of Work (SOW), and all furnished and referenced instructions.

1.1.1 This SOW is organized as follows:
Paragraph TOPIC:

1.0 General Information

2.0 Project Criteria

3.0 Cost and Scope Limitations

4.0 Delivery Schedule

5.0 Architect Engineer Services

6.0 Initiation of Work

7.0 Government Review

8.0 Travel

9.0 Submittals

1.1.3 Project Description: The contractor will be required to conduct a limited site survey, evaluate energy, evaluate energy savings, estimate construction costs, water savings and provide a cost to savings ratio associated with repairing leaks to the domestic water distribution system. The contractor shall survey the distribution system and prepare a comprehensive report documenting all work performed and results.

The leak detection survey is to cover the full length of each line designated. All lines shown on attached maps will be surveyed except those marked in yellow. Work to be performed between 15 April and 30 September 1995. The Contractor will not inject any gas or air into the lines to aid in the survey. Any excavation by the contractor must be approved by Fort Richardson Public Works before proceeding. Shut down of isolated lines will

be permitted for the duration of 20 minutes once per day. The A/E shall submit, for approval, a testing plan prior to initiation of the study.

1.1.3.1 Contractor Experience: The contractor performing the leak detection survey must have been actively engaged in this type of work for five years.

1.1.3.2 System Characteristics:

a. System pressure-50 - 90 psi

b. Hydrant type-Dry

c. Buried depth-10 ft.

1.1.3.3 Fort Richardson Public Works Services:

a. System maps

b. Provide services of one worker to open/close valves and traffic control.

1.1.3.4 Reports: The contractor shall provide the following reports:

a. Daily Report - This report will show time spent, area surveyed, leaks located, leak rates, and any problems encountered.

b. Final Report - This report will show total time spent, maps showing all leaks, all lines, all valves & shutoffs and hydrants, methods used to detect leaks and the estimated cost to repair each leak. Cost estimate to show both material and labor. The final report must also include the estimated annual water savings (millions of gallons per year)

2.0 Project Criteria:

2.1 Government Furnished Materials and Equipment:

a. US Army Corps of Engineers, Architectural and Engineering Instructions - Design Criteria, 9 Dec 1991.

b. Energy Conservation Investment Program (ECIP) Guidance, dated 10 Jan 1994.

c. TM5-785, Engineer Weather Data.

d. TM-813.5 "Water Supply, Water Distribution", Nov 1986.

e. Tri-Service Military Construction Program (MCP) Index, dated 28 Feb 1991, or latest edition.

f. MCACES-Gold cost estimating guidance, program and database, diskettes, and licensing agreement.

3.0 Cost and Scope Limitations:

3.1 Cost Limitations: The construction cost limitation for this project is undefined. The contractor will be responsible for developing the cost based upon the scope constraints for this project.

3.2 Cost Estimate:

3.1.2 Cost Estimate Format: Cost estimates shall be prepared using the latest version of Micro Computer Aided Cost Engineering System (MCACES)-GOLD, Version 5.20J or greater, with the appropriate labor equipment and material data bases. MCACES-GOLD will be provided to the contractor by the Cost Engineering Branch of the Alaska District Corps of Engineers at no cost. Upon completion of the contract, the contractor will return all material to the Government. The Alaska District is using a Standard Work Breakdown Structure (WBS) for all military and civil work cost estimates. Corps format for cost estimates will be made available for use on other cost estimate requirements.

4.0 Delivery Schedule: The work, other related data, and services required in accordance with the contract shall be accomplished with the limitation of projects scope. The schedule for delivery of data to the Contracting Officer is in calendar days. Calendar days for each requirement extend from the date of the Notice to Proceed (NTP) or approval for each item, except as otherwise noted.

	Item	Delivery Schedule	Review/Conference Time/Location
(a)	Interviews and Site Survey	~~30 days following NTP~~ 15 APR - 30 SEP 95	Not Required
(b)	Interim Submittal	60 days following approval	28 days/Post
(c)	Final Submittal	21 days following Interim Rev. Conf.	Not required

Note: The contractor shall proceed to the Interim Submittal without written notice from the Contracting Officer/authorized representative.

5.0 Architect-Engineer Services:

5.1 Interim Submittal: The interim submittal shall fulfill the requirements of paragraph 1.1.3 of the General Scope of Work.

5.2 Final Submittal: The final submittal shall fulfill the requirements of paragraph 1.1.3.4 (b) of the General Scope of Work. The Government may back-check all documents which comprise this submittal. The documents, if found incomplete, shall be returned to the contractor for further work which shall be performed at no additional cost to the Government.

6.0 Initiation of Work: The contractor shall not proceed nor initiate any work nor any succeeding design level of the work required under this SOW prior to receipt of award. Any work done without being directed to do so by the Contracting Officer/authorized representative shall be at the contractor's own risk.

7.0 Government Review:

7.1 Value Engineering: Not Used.

7.2 Review: The Contracting Officer or his authorized representative may furnish the contractor review comments on the data submitted. The contractor shall incorporate all accepted review comments in the development of data for the next submittal. The documents, if found incomplete, shall be returned to the contractor for further work which shall be performed at no additional cost to the Government.

8.0 Travel: Out of town travel is anticipated to Fort Richardson at Anchorage, Alaska.

9.0 Submittals: All submittal shall be received at the Alaska District Engineer Offices, Design Management Section, Military Technical Engineering Branch in accordance with the design schedule in Section 4.0 above.

9.1 A dated submittal letter shall be provided with each submittal to the Contracting Officer with distribution to agencies listed. This letter shall indicate to whom and the number of copies to be mailed to the agencies listed via overnight, hand, or telefax delivery service by the contractor.

9.2 The A/E shall make direct distribution of correspondence, minutes, report submittals, and responses to comments as indicated by the following schedule:

AGENCY	EXECUTIVE SUMMARIES / REPORTS / CORRESPONDENCE / FIELD NOTES
Commander, 6th Infantry Division (Light) ATN: APVR-RPW-PW-EN (Timmons) 600 Richardson Drive, Building 6500 Fort Richardson, AK 99703	7 7 1 1*

Commander, 6th Infantry Division (Light) ATTN: APVR-PW-O (Berg) Building 730, Fort Richardson, AK 99505-5500	3	3	1	-
Commander, USAED, Mobile ATTN: CESAM-EN-CC (Battaglia) P.O. Box 2288, Mobile, AL 36628-0001	1	1	1	-
Commander, USAED, Alaska ATTN: CENPA-EN-TE-DM (Jacobs) P.O.Box 898, Anchorage, AK 99506-0898	7	7	7	1*
Commander, USAED, Alaska **ATTN: CENPA-CO-FR (Shuman)** P.O.Box 35066, Fort Wainwright, AK 99703-0066	1	1	1	-
Commander US Army Logistics Evaluation Agency ATTN: LOEA-PL (Keath) New Cumberland Army Depot New Cumberland, PA 17070-5007	1	-	-	-
Commander US Army Corps of Engineers ATTN: CEMP-ET (Mr. Gentil) 20 Massachusets Avenue, NW Washington, D.C. 20314-1000	1	-	-	-
Commander US Army Engineer Division, North Pacific ATTN: CENPD-PE-TE (Mr. Pinkham) P.O.Box 2870 Portland, OR 97208-2870	1	1		

*Field Notes Submitted in final form at interim submittal

The Contracting Officer's Representatives for this delivery order shall be Mr. Claude V. Vining, Douglas Klug and Trillis B. Enders of the Alaska District Corps of Engineers.

24 August 1994

Basis of Fee

Water Conservation Study
Fort Richardson, AK

This Basis of Fee has been prepare in accordance with the above titled Request for Proposal, dated 18 August 1994, to be performed as part of the Energy Engineering Analysis Program (EEAP).

Study

EMC, Inc. will conduct an underground leak detection study on all piping identified on the water maps. The leak detection survey will be performed by our subcontractor, M.E. Simpson Co. Inc., Valparaiso, Indiana. We understand the extent of the piping system to be studied is 52 miles. The study will include:

- A work schedule;
- A kickoff meeting with site personnel to ascertain the problems with the Fort Richardson water system and to get acquainted with Fort Richardson;
- An Engineers on site to obtain waterline, pump and capacity data. A crew of 2 Technicians with appropriate equipment (transducers, ground microphones, correlator and other) to conduct the leak detection study;
- daily progress reports during the survey identifying leaks found and areas serviced;

Site Audit Report

We will write a site audit report which compiles and presents the information acquired during the site visit. Comments from Fort Richardson personnel regarding the waterline status and waterline data will be incorporated into the report. The report will incorporate an estimate of the quantity of water lost due to the leaks found in the system, and a presentation of other energy/water saving opportunities.

The first version of the report will be presented at the interim submittal date. The second and final version of the report will be submitted at the final submittal date. We understand you may want to make a few corrections or clarifications to the final submittal.

The report will include an executive summary, the narrative section, and documentation including an ECO analysis, cut sheet/drawings, and LCCA summary sheet(s). The report will also include a waterline map showing locations of leaks, a cost estimate and computer printouts, where applicable.

In addition to the report preparation, we will prepare the DD1391 form for your review.

We will submit monthly progress reports.

Meetings

- We understand there will be one meeting at the interim review time period. We have made allowances for the Project Engineer to attend the meeting. We are confident your questions will be answered by the Project Engineer.

Schedule

- We are secure with your projected schedule as laid out in paragraph 4.0 of Annex A with one stipulation. We do not believe the contract will be awarded in time for us to complete the field survey before 30 September as required by the Scope of Work. We ask that the schedule be extended so that we can do the field work in May of 1995. We could accelerate the schedule at that time if you require completion for the 1996 funding cycle.

Additional Assumptions

The map we provide to Fort Richardson will not meet the COE requirements as a master plan utility map.

DEJ/jls(7)

EMC ENGINEERS, INC.

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Denver, Colorado 80227-3400
303/988-2951 • Fax: 303/985-2527

CONFIRMATION NOTICE

Confirmation Notice No. 1 EMC #1406-007

DATE: 15 June 1995

PROJECT: Ft. Richardson Water and Energy Study
CONTRACT NO.: DACA85-94-D-0033

NOTES PREPARED BY: Michael Scholz
E M C Engineers, Inc.

DATE OF MEETING: 31 May 1994

PLACE OF MEETING: Ft. Richardson, Bldg. 730, conference room

SUBJECT: Project Kick-off Meeting

ATTENDEES:
Mr. Randall Jacobs/COE, Alaska
Ms. Pat Oien/Ft. Richardson
Mr. Paul Knauff/Ft. Richardson
Mr. Bill Garnand/Ft. Richardson
Mr. Darron Wood/Ft. Richardson
Mr. Mike Simpson/M.E. Simpson Co., Inc.
Mr. John Van Arsdale/M.E. Simpson Co., Inc.
Mr. Michael Scholz/EMC Engineers, Inc.

The following is a summary of the items discussed, the comments made, and the decisions made during the meeting.

The meeting kicked off with an explanation of how EMC Engineers, Inc (EMC) anticipated conducting the survey. M.E. Simpson personnel were introduced and they discussed the leak detection portion of the study. A discussion of the Scope of Work (SOW) followed and the SOW was reviewed.

- Remove the following from leak testing scope: Richardson Dr. from 8th Ave to 5th Ave. Mr. Simpson mentioned the area will probably be checked anyway to complete leak checks on adjacent pipes;
- Add the following to the leak testing scope: The 14" and 20" line on the east side of Highway 1 to the water treatment plant. Mr. Simpson agreed;

- Mr. Scholz mentioned the lack of sections 7.6.1 and 1.1.3.4 as listed in sections 5.1 and 5.2 of Annex A of the Scope of Work. This shouldn't raise a problem for EMC since we will proceed with energy analysis as we have with other projects. All concurred;
- Mr. Wood mentioned most of the leaks surface. He is suspicious about some joints on the 20" main on the east side of Highway 1. They do have some bleed valves and one or two PRV's which he will show to M.E. Simpson personnel;
- Mr. Wood has a copy of "FIRMS" database which he will share with EMC
- Further description of the water network by the Ft. Richardson personnel is as follows:
  - -Ft. Richardson has a number of circulating pumps;
  - -The Post has one pump station along the Davis Hwy;
  - -Ft. Richardson has a number of wells and a 2.5 million gallon reservoir;
  - -The Post's water network starts at the river, gravity drains to the water plant, then gravity feeds into the distribution system;
  - -A portion of the estimated 4-5 million gallons used per day is consumed by Elmendorf Air Force Base;
  - -Some fire hydrants are used to supply irrigation water to the golf course;
  - -Ft. Richardson has replaced approximately 33 fire hydrants in three years, and;
  - -The majority of Post's distribution system was installed in the 50's and 60's
- They have had a large downsizing at Ft. Richardson which has resulted in the demolition of some of the WWII buildings;
- Mr. Wood estimates a system pressure of 55psi at the highway and 90 psi at the bottom end of the system.
- Mr. Knauff mentions a daily report by M.E. Simpson is not necessary. They should however, check in with Mr. Wood.
- Mr. Jacobs states that all seem to be in agreement for what they expected.

This meeting was adjourned.

Michael J Scholz

MJS/nj w:\mike_s\1406-007\conf1.doc

Action Required: no action required

cc: attendants
D. Jones
T. Poeling

If any portion of this Confirmation Notice is incorrect, please notify us immediately. If correspondence is not received to the contrary within 14 days, it will be assumed that the decisions, conclusions, and status outlined in this Confirmation Notice are correct.

EMC ENGINEERS, INC.

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303/988-2951 • Fax: 303/985-2527

CONFIRMATION NOTICE

Confirmation Notice No. 2 EMC #1406-007

DATE: 21 September 1995

PROJECT:
CONTRACT NO.: FY94 Water Conservation Study

RESPONSE
PREPARED BY: E M C Engineers, Inc.

SUBJECT: Response to comments from review of Fort Richardson, Alaska Interim Submittal

Response to Comments from Mobile District (Battaglia):

1. ES: Pages ES 1 & ES 2 are transposed; please correct.
   RESPONSE: Will comply.

2. ES: The Executive Summary should summarize the recommendations. Please include the results of the Life Cycle Cost Analyses.
   RESPONSE: Please reference Table ES-1 which summarizes the results of the LCCA. The Recommendations Section shall be updated for the Final Report.

3. General: Some grammatical errors, typos, etc. have been noted. Please proofread carefully and correct.
   RESPONSE: Will comply.

4. Pg. 2-3 Par 2.2.1: The third paragraph discusses the frequency range of sounds made by leaks. Please include a brief discussion on how one differentiates between leaks and water flowing through the pipe to point of use.
   RESPONSE: A brief discussion regarding the frequency range of sounds made by piping leaks shall be included in the Final Report.

5. Pg. 3-2: In the discussion of pump electrical consumption, both the backwash pumps and the circulating pumps are included. I don't see how the energy consumed by the circulating pumps can be directly proportional to the total quantity of water used by the system. Either delete this from the overall savings, or present adequate justification for including it.
   RESPONSE: This calculation was based upon the total annual energy consumption for

all associated pumps in the water distribution system divided by the total annual water consumption. Water consumption was based on metered data provided by Ft. Richardson personnel. Electrical consumption was based on electrical rates and pump operating schedules provided by Ft. Richardson personnel.

6. Pg. 3-9: Fourth "bullet": in the appendices please include a calculation to back up the $250 per mile cost of the leak detection survey.
RESPONSE: Cost of leak detection survey is based upon direction from the American Water Works Association (AWWA) Manual 36, "Leak Detection" and upon the historical data of previous leak detection surveys. Validation of leak detection cost shall be included in the Final Report.

7. Pg. 3-9 RESULTS: The 9% mentioned in the first sentence corresponds with the "Recoverable Leakage" presented in Table 3.5. Please revise the sentence so that it will be consistent with the information presented in the table.
RESPONSE: The value for Recoverable Leakage presented in Table 3-5 summarizes the water audit. The value for Recoverable Leakage in Table 3-6 summarizes the LCCA. These values represent the same number. It is this value that the sentence is referring to.

8. ECO 5: General Investigating the implementation of the leak detection program is a very good idea, but a very important cost has been neglected in the analysis. Since the quantities and types of leaks cannot be known ahead of time, some assumptions would have to be made; but I think you could come up with something based on historical data.
RESPONSE: The direction for cost data from the AWWA is that repair costs are not included because leaks are normally repaired anyway during the normal course of the maintenance of the water distribution system.

9. Pg. 3-9 Table 3.6: See Comment 8 above.
RESPONSE: Please see response 8 above.

10. Pag. 4-1 Table 4.1: See Comment 8 above
RESPONSE: Please see response 8 above.

11. Pg.4-2 For the final submittal, suggest project documentation be presented for only two projects, i.e., ECO4 & ECO5 is a combination of 1 through 3.
RESPONSE: Agree. Programming documentation for the Final Report shall be performed for ECOs 4 and 5.

12. General: Number pages of appendices.
RESPONSE: Will comply.

13. App C: Include water maps referenced in table.
RESPONSE: Red-lined copies of existing water maps which show the location of leaks discovered during this leak detection survey shall be included with the Final Report.

14. App D ECO 5: See Comment 8 above.
RESPONSE: Please see response 8 above.

Response to Comments from Ft. Richardson Department of Public Works (Oien):

15. Pg 2-2. Reference to Fort Polk personnel seems to be incorrect. Shouldn't it be changed to Ft. Richardson personnel?
RESPONSE: Concur. Reference shall be changed to Fort Richardson personnel.

16. Pg. 2-3 How are leakage quantities estimated?
RESPONSE: Leakage quantity estimates are based on the observation and experience of the leak detection technician. Leaks were visually inspected by the technician, who will estimate the quantity based on the size of the leak, size of the pipe, pressure in the pipe, and previous measurements based on AWWA guidelines.

17. Pg 2-2: Where did the annual operating hours of the pumps come from? In reference to Appendix D, the reservoir pump and recirculation pump estimated hours of operation do not match Table 2.1.
RESPONSE: The annual operating hours of pumps at Fort Richardson were taken from estimates given by Fort Richardson personnel. With regards to Table 2.1, values for annual operating hours and motor size for the reservoir pumps and recirculating pumps are incorrectly inverted. The recirculation pump has a 20 hp motor that operates approximately 5,125 hours per year. The reservoir pump has a 30 hp motor that operates approximatly 1,100 hours per year. The values used for calcuation of the pump electrical consumption in Appendix are correct. Table 2.1 shall be corrected for the Final Report.

18. Pg. 3-8: For calculation of the domestic water consumption, why weren't the Army family members and other DOD family members under Military Retirees included in the water audit worksheet.
RESPONSE: The assumption was made that family members of Military Retirees (which do not reside on post) do not consume enough water at Fort Richardson to be included in the consumption figures. It was confirmed during the review meeting that this group of people would not contribute significantly to the amount of water consumption on post. Explanation of this assumption shall be included in the Final Report.

19. General: Can the A/E put a copy of the map indicating what areas of the distribution system were surveyed. A red-lined copy of the map given to the A/E would be sufficient. This would provide for future reference of what was surveyed.
RESPONSE: Please see response 13 above.

20. General. Five copies of the Final Report is sufficient for DPW.
RESPONSE: Will comply.

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cc: R. Jacobs/COE Alaska
T. Battaglia/COE Mobile
P. Oien/P.W. Ft. Richardson
D. Jones/EMC
T. Poeling/EMC
File

EMC ENGINEERS, INC.

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CONFIRMATION NOTICE

Confirmation Notice No. 3 EMC #1406-007

DATE: 5 October 1995

PROJECT:
CONTRACT NO.: FY94 Water Conservation Study

RESPONSE
PREPARED BY: E M C Engineers, Inc.

SUBJECT: Response to comments from review of Fort Richardson, Alaska Interim Submittal

Supplemental Response to Comment No. 5 from Mobile District (Battaglia):

Pg. 3-2: In the discussion of pump electrical consumption, both the backwash pumps and the circulating pumps are included. I don't see how the energy consumed by the circulating pumps can be directly proportional to the total quantity of water used by the system. Either delete this from the overall savings, or present adequate justification for including it.

RESPONSE: This calculation was based upon the total annual energy consumption for all associated pumps in the water distribution system divided by the total annual water consumption. Water consumption was based on metered data provided by Ft. Richardson personnel. Electrical consumption was based on electrical rates and pump operating schedules provided by Ft. Richardson personnel.

The circulation pumps (calculations in Appendix D) are used at Ft. Richardson to maintain water pressure and flow during periods of high demand. Since the high demand period is variable, and therefore, not separable from the normal demand period, the pump usage should not be deleted.

The amount of energy consumed by the circulation pumps is negligible when compared with the overall energy used in the water system ($0.0046/Kgal, page D-4 and D-5).

One of the circulation pumps, the recirculation pump, is also used because the usage rate in the Circle Drive area is not high enough to properly circulate the water to avoid freezing of the lines. We did not assume the water usage in this area did not exist. The water usage in the recirculation lines is a function of the amount of water required to fill the lines plus the

amount of water consumed. Water consumption consists of water lost to leakage and water used in daily activities.

Michael J. Scholz

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cc: R. Jacobs/COE Alaska
T. Battaglia/COE Mobile
P. Oien/P.W. Ft. Richardson
D. Jones/EMC
T. Poeling/EMC
File

USARAK

MISSION

COMMAND AND CONTROL US ARMY FORCES IN ALASKA. PROVIDE THE SERVICES, FACILITIES, AND INFRASTRUCTURE TO SUPPORT POWER PROJECTION AND TRAINING TO RAPIDLY DEPLOY US ARMY FORCES FROM ALASKA IN THE CONDUCT OF CONTINGENCY OPERATIONS WITHIN THE PACIFIC THEATER AND ELSEWHERE AS DIRECTED.

METL

- DEVELOP AND MAINTAIN A POWER PROJECTION PLATFORM FOR THE RAPID DEPLOYMENT OF FORCES.
- SUPPORT AND SUSTAIN THE TRAINING OF US ARMY FORCES WITHIN ALASKA.
- SUSTAIN THE FORCE.
- PROVIDE DISASTER RELIEF, HUMANITARIAN ASSISTANCE, AND COUNTER-NARCOTICS OPERATIONS WITHIN ALASKA AND ELSEWHERE AS DIRECTED.

USARPAC Mission

- Serve as the Army Component Command to Commander-in-Chief, U.S. Pacific Command (USCINCPAC) ~~less the geographical (USCINCPAC)~~ less the geographical area of Korea, and for matters of USCINCPAC concern beyond the exclusive authority or transcending the geographical area of Commander, Eighth United States Army.

- The United States Army, Pacific will command and support assigned and attached active United States Army and United States Army Reserve units, installations, and activities in Alaska, Hawaii, Japan, and in possessions and trust territories administered by the United States in United States Pacific Command (USPACOM)

- The United States Army, Pacific is further designated coordinating authority for resource management in USPACOM and will perform theater-wide functions for the Army as directed by the Department of the Army.

HQDA GO 13, 22 Aug 90, Eff 30 Aug 90, Sec II

USARPAC MISSION ESSENTIAL TASK LIST
(Revised as of 13 Jan 93 based on USARPAC/USCINCPAC Staffing)

1. Organize, equip, man, and train units in the Active and Reserve Components to mobilize, deploy, and fight in the defense of U.S. interests worldwide, particularly as the Army Component of a Joint Task Force in the Asia-Pacific Region, and win.

2. Develop and be prepared to execute major and lesser regional contingency operations' plans including noncombatant evacuation operations (NEO), counterdrug operations, disaster relief, humanitarian assistance/civil affairs operations, and military support to civil authorities in support of USCINCPAC.

... and allied

APPENDIX B

FIELD SURVEY NOTES

Field Survey Notes
Data Supplied by Ft. Richardson

FIELD NOTES:

Kick-off Meeting at Ft. Richardson

DATE: 31 July 1995

PROJECT: 1406-007
CONTRACT NO.:

NOTES PREPARED BY: Michael Scholz
E M C Engineers, Inc.

DATE OF MEETING: 31 May 1995

PLACE OF MEETING: Building 730/Building 700

SUBJECT: Project Kick-Off Meeting

ATTENDEES: Paul Knauff, Pat Oien, William Garnand, Randy Jacobs, Darron Wood/ Ft. Richardson,: Mike Simpson and John Van Arsde/ ME Simpsonl, Michael Scholz

The following is a summary of the items discussed, the comments made, at the kick off meeting.

- Remove from scope the waterline-Richardson Drive from 8th to 5th.
- Discussion continued about EMC's understanding of scope. EMC did not have section 7.6.1 or 1.1.3.4 (b) as reported in 5.1 and 5.2 of Annex A. EMC received an updated scope of work which clarified the points.
- Mr. Wood mentioned most of water leaks surface. He would like to replace 20" bell joints (lead).
- Mr. Wood has "FIRMS" list of hydrants and a computer data base.
- Mr. Wood mentions the system has:
  some bleed valves ;
  one or 2 PRV;
  Circulation valves; and
  1 pump station for fire demand along Davis Hwy
- The water facility has:
  a number of wells
  and a 2.5 mg reservoir.
- The system is gravity fed from river to filtration plant then to system.
- The water plant 4-5 MGD production is not all consumed at Ft. Rich some to Elmendorf (4 meters). Newer Bldg's. such as Armory have meters.
- System pressure is 55 psi at highway 90 psi at bottom end.

- Mr. Wood thinks there is fire hydrant use for irrigation.
- They've replaced about 33 fire hydrants in 3 years
- For the most part all waterline distribution system was installed in 50's & 60's
- Cool turbine #1 at power plant with 20" line.
- The 21" and 14" waterlines go across Highway 1-to the water treatment facility. We don't have drawings of that area. M.E. Simpson has no problems with verifying leaks on line. We will get drawings of the area.
- No hydrants on 20"CI at all.
- There has been a large downsizing at Ft. Rich and they have done away with WWII structures. Ft. Richardson SOP for abandoning a service line is to: cut (service) pipe, bend it and braize the end when abandoning the building..
- Mr. Knauff says a daily report isn't necessary. Reporting in to the facility as we normally do it is o.k.
- Mr. Jacobs is at 21700 at Elmendorf. States that it sounds like we will deliver what Ft. Richardson wants.

End at 10:00

5/31/95-Windshield Tour with Mr. Wood & M.E. Simpson

- 14" & 20 " are connected at various points
- At power plant 80 psi, 35 at golf course.
- Keeps one well going till June
- VA hospital to replace Philippines
- Camp Carroll in National Guard water users with no meter
- Armory users with no meter
- Cemetary-no meter
- 1 Fire Pump at Davis Hwy.
- 1 Deluge system at hangers
- Circulating pump and heat exchanger on the outer loop to the reservoir

5/31/95-at Cemetery to correlate on a leaking line.

- Darron says "FIRMS" Hydrant info.-residual pressure is from 1 pilot gauge at open hydrant.

5/31/95 Fire Pumps Davis Hwy.

<u>Pump House Standard Operating Procedure</u>

Pump #1
Set point 120# Differential-10#off a 120# on position<110# desired operation (on constant)

Pump #2
Set point at 90# Differential-16# off at 100# on position 80# desired open (Backup #1)

Pump #3
Set pt. 50# Differential-20# off at 70# on at 50# desired open (fire only)

Pump #1 Label Data

Balder Industrial Motor- Ft. Smith, Arkansas
three phase
Cat. No. M3219T
Spec. 36B01-194
Frame 184T Set F1092
HP 7 1/2 DP
Volts 208-230/460
Amps 19-18/9
RPM 3450 Class B
Hz 60 Code J
Ser F 1.15 Des. B P.F. 91%
Nema Nom Eff. 85.5%
Rating 40C AMB cont.

Pump #2 Label Data

Baldor (Same as #1)

Pump #3 Label Data

HP 40 PH3 Class B Hz 60,
Frame 286JP, Volts 230/460, Amps 94/47.
SF 1.15, RPM 3515
Lower or shaft end bearing: 63M-J; Upper: 6209-ZZ-J R209411
I.D. #9500237-756, RO77393 E

6-1-95 Visit with Steve Heightmeyer
347-1785 or 1786 Water Plant

- Pump at 2.5 million gal. storage tank probably operates a max 4 hrs non-continuous per day at 1000 gpm. Pump required to go against static 28.34 psi. Pump puts out 30 psi to overcome system head.
- PCSI-2000-Phoenix Control System (Ariz.) is program they use to monitor the system. It operates strictly manual from computer at water plant.
- Each well and tank has an RTU (Remote Telemetry Unit).
- Elmendorf estimates are based on 7 year average for month, because the meters are presently down.

Other User's of Water include:

-Car Wash - (2 on Post by D Street and 2nd)
-Burger King
-Commissary
-Men's Halls
-Steam Plant
-Elemdorf
-Golf Course - (major user late April-Sept./Oct.)
-Roads & Grounds - (tanker to wash streets, 6 loads/day-500 gals/load>1wk/mon. 5 mons.)

6-1-95 Review of equipment at well stations

Well #3

Vert. Turbine

AC Motor A.D. SmithCorp, Tipp City, OH
HP 150FRA505P 3 PH 440 volts
Cycles 60 Model 505-296B
RPM 1760 Amps 172
°C Rise 40 Type 12BV
Code F 3-D 57 Ser. No.
Duty Continuous

Chlorine pump-GE

Mod 5KC33MN2020
Serial # NFJ
HP3/4

V&H 115/230	Hz60, PH1
RPM 3450	CODE L
A	SFI.5
SFA 14.8/7.4	FR56C
AMB 40c	Insul Class B

Rating Continuous

Well #2

Meter reading 00040200

Chlorine Pump

Century, St. Louis MO
Part 8-130527-22 Type CS from J56C
Volts 230/115 Form KXS PH1, Insul A, Code K
HP 3/4 Amps 4.6/9.2 SF1.5
RPM 3450 Conn Diag 115242 Ser No N3 Cont. 40

Vert. Turbine-Siemens

Ord. No. AS210 C231189 Date Code 289
Type HSRG3V Frame 505P
HP 200 Service Factor 1.15
Amps 233 Volts 460 PWS
RPM 1785 Hertz 60 3PH
Duty Cont Nom Effic. 93.6, Motor wt. 2750
Insul. Class F NEMA Design B, KVA Code G
Opened BRG 110BT03MXXDO

Well #1

#1 Chlorine Pump
Can't read tag-similar to others

Vert. Turb. Pump
A.D. Smith Co.
H.P. 75 FrA504-PS 3PN 220/440 volts
Cycles60 Model 504-3173C
RPM 1700
C Rise 40°C
Code F
Duty Cont.
Amps 1ZBV
Design B 73634 Ser. No.

6-2-95 at 2.5 mil gallon pump house
Located at Reservoir

- Pumps against head from Watrer rTreatment Plant

Tag information

HP 30 PH3 Hz 60

Frame	286TCV	volt 230/460, Amp 78/39
Design B	Code G	SF I.15
60°C Rise	RPM1750	
Lower Brg	6311-J	6209-2Z-J
ID9605296-891		R2100 554
US Motors		

6-2-95 Meet with Randy Jacobs
Reviewed progress of study, debriefing meeting.

6-2-95 Recirculation Bldg. on N. Warehouse Road, Bldg. 807

Recirculates water around warehouse loop. Used for freeze protection, area gets low use.
Tag Information:

HP 20, PH3, HZ60, RPM 1170, Code G, Nema B Design
Frame 286T, Type DP SF 1.15, Nema nominal effic. 88.5, Max AmB 40°C
Volts 230/460
Fl. Amps. 50.8/25.4 I.D. E828 AW01V338RO73F
Shaftend Brg. 6211-2Z-J/C3
Opp. End Brg 6207-2Z-J/C3

Usable on 208 V, 60HZ, 56.7 amps, 1.0 S.F.

- Line pressure on gauge is 54psi
- Steam Pressure=12.3 psi
- Cond. Return=7.0psi

Hoffman-Watchmen Condensate Unit (For HX in recirculation building)

Series-WCS	Model WCSD-12-20-B
Serial-160013	B39
GPM 18	PSI 20
Volts 115, PH1HZ 60	
	ITT Bell & Gossett
	Motron Grove, Il 60053

2 Jet Pumps

Emerson-St. Louis, MO	
Model CA55CXDCF-1962	S.F. 1.85
HP=1/3 RPM 3450	PH1, Code M
V115/230	HZ 60
A 6.0/3.0	SFA 8.2/4.1

Temp. of Water in=76°

Installation
Fort Richardson
MARCH 27, 1995

	Current Rates for FY 94			Current Rates for FY 95		
	A	H	B	A	H	B
Electricity						
Plant	$0.0491	NA	$0.0539	$0.0516	NA	$0.056
Distribution	$0.0630	$0.0630	$0.0705	$0.0633	$0.0633	$0.070
Steam						
Plant	$4.9506	NA	$5.2403	$5.0003	NA	$5.291
Distribution	$7.0438	$7.0438	$7.5745	$7.0693	$7.0693	$7.600
Water						
Distribution	$0.6890	$0.6890	$1.0769	$0.7115	$0.7115	$1.100
Elmendorf AFB	$0.4239	NA	NA	$0.5308	NA	NA
AWU from Ship Creek	NA	NA	$0.0330	NA	NA	$0.037
Alaska Fish/Game	NA	NA	$0.1482	NA	NA	$0.145
Sewage	$1.4091	$1.4091	$1.6390	$1.5628	$1.5628	$1.797
Refuse	$3.3956	$3.3956	$3.6464	$2.8615	$2.8615	$3.094

Prepared by
Pat Olen
Telephone #
384-3176
March 27, 1995

Electricity & Steam
From 1 OCT 93 To 30 SEPT 94

NET ENERGY USED:				
Purchased Electricity (ML&P Bills)			18,028,000	kwh
Electric Generation (J3200/PP reports)			54,613,000	kwh
Subtotal			72,641,000	kwh
Loss%	4		2,905,640	kwh
Net Electric			69,735,360	kwh
Total Steam (PP reports)			1,551,190	klbs
Steam to Electricity			681,816	klbs
Steam to Heating			869,374	klbs
Loss %	15		130,406	klbs
Net Heating			738,968	klbs
MAKEUP WATER			26309	KGal

Total Water Usage Steam + Electric Plant

PRORATION FACTORS FOR CAPITAL COSTS FOR CENTRAL HEATING & POWER PLANT:				
Property Book Value			$8,449,900	
Electrical Portion			$3,912,000	46.3%
Heating Portion			$4,537,900	53.7%
MAINTENANCE PRORATION:				
K1310			$391,252	
K1411			$488,257	
Subtotal			$879,509	
K1310 Labor		$324,297		
K1411 Labor		$342,748		
Subtotal		$667,045		
Labor Escalation	3.50%		$23,347	
Total Maintenance			$902,856	
Electric	46.3%		$418,022	
Heating	53.7%		$484,833	
ELECTRIC PLANT O&M:				
Purchased Electric Cost			$595,355	
Date of last rate change			NA	
Recalculated Cost			$595,355	
Operations(J3200)			$3,280,750	
J3200 Labor		$1,152,912		
Labor Escalation	3.50%		$40,352	
Maintenance			$418,022	
Water Service			$7,968	
11,564 KGal				
$0.6890 per KGal				
Total Electric Plant O&M			$3,747,092	
STEAM PLANT O&M:				
Operations(J4110)			$3,813,475	
J4110 Labor		$1,105,317		
Labor Escalation	3.50%		$38,686	
Maintenance			$484,833	
Water Service			$10,159	
14,745 KGal				
$0.6890 per KGal				

Total Steam Plant O&M		$4,347,154	
CAPITAL CHARGE FOR ELECTRICAL PORTION OF PLANT:			
Property Book Value		$3,912,000	
Annual Amortization		$391,200	
Capacity		122,640,000	kwh
Firm	18,000 kw		
Less	4,000 kw		
Unit Cost		$0.0032	per kwh
ELECTRIC DISTRIBUTION SYSTEM MAINTENANCE:			
Overhead K1321		$574,797	
Labor	$425,634		
Labor Escalation		$14,897	
Subtotal		$589,694	
Underground K1322		$73,762	
Labor	$53,969		
Labor Escalation		$1,889	
Subtotal		$75,651	
Transformers K1330		$1,778	
Labor	$1,072		
Labor Escalation		$38	
Subtotal		$1,816	
Substations K1350		$0	
Labor	$0		
Labor Escalation		$0	
Subtotal		$0	
Total		$667,161	
CAPITAL CHARGE FOR ELECTRICAL DISTRIBUTION SYSTEM:			
Property Book Value		$2,721,700	
Annual Charge		$272,170	
Unit Cost		$0.0022	per kwh
SUMMARY OF ELECTRIC RATES:			
Plant Rate A			
Plant O&M		$0.0516	per kwh
Plant Rate A		$0.0516	per kwh
Plant Rate B			
Plant Rate A		$0.0516	per kwh
Plant Capital		$0.0032	per kwh
Subtotal		$0.0548	per kwh
Admin/Overhead		$0.0016	per kwh
Plant Rate B		$0.0564	per kwh
Distribution Rate A			
Plant O&M		$0.0537	per kwh
Distribution Maintenance		$0.0096	per kwh
Distribution Rate A		$0.0633	per kwh
Distribution Rate B			
Distribution Rate A		$0.0633	per kwh
Distribution Capital		$0.0022	per kwh
Plant Capital		$0.0032	per kwh
Subtotal		$0.0687	per kwh
Admin/Overhead		$0.0021	per kwh
Distribution Rate B		$0.0708	per kwh
CAPITAL CHARGE FOR STEAM PORTION OF PLANT:			
Property Book Value		$4,537,900	
Annual Charge		$453,790	
Capacity		3,311,280	klbs

Electric Dist. Rate

B-11

4	Boilers		
135	klb/hr		
70	%		
Unit Cost		$0.1370	per klb

STEAM DISTRIBUTION SYSTEM MAINTENANCE:			
K145i		$856.959	
Labor	$566.927		
Labor Escalation		$19.842	
Total		$876.801	

CAPITAL CHARGE FOR STEAM DISTRIBUTION SYSTEM:			
Property Book Value		$5,731,400	
Annual Charge		$573.140	
Unit Cost		$0.1731	per klb

SUMMARY OF STEAM RATES			
Plant Rate A			
Plant O&M		$5.0003	per klb
Plant Rate A		$5.0003	per klb
Plant Rate B			
Plant Rate A		$5.0003	per klb
Plant Capital		$0.1370	per klb
Subtotal		$5.1374	per klb
Admin/Overhead		$0.1541	per klb
Plant Rate B		$5.2915	per klb
Distribution Rate A			
Plant O&M		$5.8827	per klb
Distribution Maintenance		$1.1865	per klb
Distribution Rate A		$7.0693	per klb
Distribution Rate B			
Distribution Rate A		$7.0693	per klb
Distribution Capital		$0.1731	per klb
Plant Capital		$0.1370	per klb
Subtotal		$7.3794	per klb
Admin/Overhead		$0.2214	per klb
Distribution Rate B		$7.6008	per klb

LOCAL PREVAILING RATES: As of 4/4/95			
Chugach Electric Association (563-7366)			
Small General Service			
Customer Charge		$12.50	per month
Energy Charge		$0.0823	per kwh
Royalty Settlement Surcharge		0	per kwh
Plus Purchased Fuel Adjustment		0.00555	per kwh
Regulatory Cost Charge (RCC)		0.00041	per kwh

There is no local prevailing rate for steam

B-12

Water

From 1 OCT 93 To 30 SEPT 94

QUANTITY CONSUMED:

Quantity Purchased		0	KGal
Quantity Produced		1,554,818	KGal
Subtotal		1,554,818	KGal
System Loss %	5	77,741	KGal
Quantity Used		1,477,077	KGal

Water Usage FY 94

COST OF PURCHASE/PRODUCTION:

Purchase Cost		$0	
Date of Last Rate Change	NA		
Recalculated Purchase Cost		$0	
Cost of Production (J1200)		$579,959	
Labor	$509,462		
Labor Escalation		$17,831	
Power for Pumping		$586	
Total Cost Purchase/Production		$598,376	
Unit Cost Purchase/Production		$0.4051	per KGal

Production Cost

COST OF POWER FOR PUMPING: 3 BACKWASH PUMPS, TUR 50 HP EA., 70% EFF..

Electrical Consumption

Metered	0	kwh
Unmetered	9,251	kwh
Total	9,251	kwh

Pumping Rate	$0.0633	per kwh
Cost of operating backwash pumps	$586	

Electric Cost

Estimation of Unmetered Consumption

Number of Pumps

Note: If more than 3 pumps enter overall average in column for pump # 1 and leave the columns for the remaining 2 pumps blank.

	Pump # 1		Pump # 2	Pump # 3
Average Pumping Head	50	ft		ft
Pumping Rate	2,750	gpm		gpm
Annual Hours of Use	250	hrs		hrs
Total kwh consumed	9,251	kwh		kwh

Total kwh consumption estimate	9,251	kwh

COST OF MAINTENANCE:

Normal Maint. (K1111-K1133)		$364,634	
Labor	$169,203		
Labor Escalation		$5,922	
Abnormal Maint	$160,000		
Abnormal Amort		$32,000	(yr 1 of 5)
Amort Maint Carry-over		$50,000	(yr 4 of 5)
Reimbursed Maint		$0	
Net Maintenance Cost		$452,556	
Unit Cost Maintenance		$0.3064	per KGal

Maintenance Cost

COST OF CAPITAL:

Acquisition Cost		$9,759,100	
Annual Charge		$975,910	
System Capacity	7,500,000	Gal per day	
Annual Capacity		2,737,500	KGal
Unit Cost of Capital		$0.3565	per KGal

RATE SUMMARY:

Unit Cost Purchase/Production	$0.4051	per KGal
Unit Cost Maintenance	$0.3064	per KGal
Rate A	$0.7115	per KGal

Total Water Cost

Rate A		$0.7115	per KGal
Unit Cost of Capital		$0.3565	per KGal
Subtotal		$1.0680	per KGal
Admin/Overhead		$0.0320	per KGal
Rate B		$1.1000	per KGal

Elmendorf AFB.Rate A adjusted to exclude 65% of distribution system maint. cost.

Total Maintenance Cost		$452,556	
K1131	$364.934		
K1131 @ 65%		$237,207	
K1131 labor	$213.966		
K1131 Labor Escalation @ 65%		$4,868	
Net		$210,481	
Total Production Cost		$598,376	
Total O&M Cost		$808,857	
Quantity at 2% Losses		1,523,722	KGal
Elmendorf Rate A		$0.5308	per KGal

Ship Creek Dam for AWU

Quantity from Reservoir			
Military		1,554,818	KGal
AWU		3,590,509	KGal
Total		5,145,327	KGal
O&M Cost			
Labor		$21,435	
500	hours		
$42.87	per hour		
Electric		$2,773	
43,800	kwh		
$0.0523	per kwh		
Maintenance(K1112)		$3,891	
K1112 Labor	$2,608		
Labor Escalation		$91	
Abnormal Maint	$0		
Abnormal Maint Cost		$0	
Abnormal Maint Carryover		$0	
Total O&M		$28,190	
Unit O&M Cost		$0.0055	per KGal
Capital Cost		$1,584,550	
Annual Charge		$158,455	
Unit Cost		$0.0308	per KGal
Rate for Sale to AWU			
O&M		$0.0055	per KGal
Capital		$0.0308	per KGal
Subtotal		$0.0363	per KGal
Admin/Overhead		$0.0011	per KGal
Rate		$0.0374	per KGal

RAW WATER FOR ALASKA DEPT OF FISH AND GAME

PUMPING COSTS:

# Wells: 2			
Pumping rate: 1200	GPM each @	425 Ft. TDH.	150 HP
Annual capacity:	1,261,440	Kgal.	
Actual volume pumped based on	water plant	logs (gal.):	145,601,000
Pump A: 192 amps			
Pump B: 195 amps			
Voltage: 440 V			
Total hours pump operation:		899	hours
Current electric rate:		$0.0516	per kwh

Power used for pumping this FY:		154197	kwh
Elec. cost for pumping.		$7,954	
Unit pumping costs:		$0.0546	/kgal.

CAPITAL COST RECOVERY:

Book value: 2 well.	$361,199		
Annual charge:	$36,120		
Unit capital recovery cost:		$0.02863	/Kgal.

OPERATION AND MAINTENANCE COSTS:

J(1300):	$3,849	costs prorated
K(1112):	$5,174	by percent of use
Unit O&M costs:	$0.06197	/kgal.

Rate	$0.1452	per KGal

Local Prevailing Rate: As of 3/26/95

AWU Commercial (564-2700)	$3.1400	per KGal

FORT RICHARDSON UTILITY PLANTS
GENERAL INFORMATION

CENTRAL HEATING AND POWER PLANT

The Central Heating and Power Plant was built in 1952, and was originally equipped with eight coal fired boilers, operating at 400 psig and 750 degrees Fahrenheit. In 1968, four of the eight boilers were converted to enable them to fire on either natural gas or oil. The plant is presently operated on natural gas with fuel oil as an emergency back up until coal fired boilers can be brought on line. The plant has on site a 50,000 gallon fuel oil storage tank. The four coal fired boilers and coal handling equipment are maintained in good operational condition and are fired during periods of natural gas curtailment and for periodic permitting/operator training. The coal stockpile is presently at 15,000 tons which is approximately a 38 day supply. For operation during prolonged natural gas curtailments, coal is supplied by rail shipment from Usibelli Coal Mine, Healy Alaska.

Electrical generation consists of three condensing type steam turbines with single extraction directly coupled to 5000 kW generators and two non-condensing steam turbines directly connected to 3750 KW generators. The total rated plant generation capacity is 22,500 KW.

The total Fort Richardson and Elmendorf Hospital heating steam loads are supplied at 90 psig, from the exhaust of the non-condensing turbines and from controlled extraction condensing turbines. Supplemental steam or all of the steam load can be supplied directly from the main steam headers through two pressure reducing stations. Condensate from Emendorf Hospital and the base heating system is returned to the condensate tank at atmospheric pressure.

Rejected heat from the condensing turbines is used in various ways. A portion of the potable supply for Fort Richardson and Elmendorf is passed through turbine condensers. This practice prevents freeze up in the domestic water lines during winter months. The cooling water from # 3 turbine condenser is discharged to a cooling pond and heat exchanger to provide tempered water for rearing fish at the State of Alaska Fish Hatchery located near the plant.

Distribution Systems

Steam and Condensate	342,000 LF
Water Mains and Laterals	463,000 LF
Sanitary Mains and Laterals	262,000 LF
Electric Distribution Overhead	944,000 LF
Electric Distribution Underground	213,000 LF
Natural Gas Distribution System	12, 000 LF

Auxiliary Generation Plant

Capacity: 6700 KW at 80% power factor 2400 volts
Equipment: Two dual fuel type 31A18, 2500 KW each at 80% power factor.
One submarine opposed piston-type, 538D8 1/8, 1100 KW at 80% power factor.
Two 32E14, 300KW at 80% power factor.

Water Treatment Plant and Complementary Facilities

The mission is to operate and maintain a water intake plant (dam structure located at ship creek reservoir) serving Fort Richardson, Elmendorf, and the greater anchorage area. To operate and maintain a water treatment plant and stand by wells that supply potable water to Fort Richardson and Elmendorf Air Force Base.

Water Intake Plant Description
Maximum intake 10,000,000 gallons per day
Water impounded by dam structure 15,000,000 gallons
Drainage area 92 square miles

Water Treatment Plant Description
Design Production 7,000,000 gallons per day
Four flocculation and settling tanks 200,000 gallons each
Eight sand filter beds
Clear well, 134,000 gallon capacity

Auxiliary Water Wells
Three wells with a total design capacity of 2700 gallons per minute are operated and maintained on an as needed basis to supplement the surface water supply mentioned above.

Sewage Disposal
Fort Richardson Sewage disposal is by contract with the Municipality of Anchorage.

E M C Engineers, Inc.
Ft. Richardson, AK
EMC #1406-007

Prepared by: T Poeling
7/19/95
Checked by: _____

MONTHLY WATER PRODUCTION

Date	Surface Water (kGal)	Well Water (kGal)	Elemendorf (kGal)	Total Consumed (kGal)
Oct-92	125,398	1,697	71,868	55,227
Nov-92	118,084	815	69,584	49,315
Dec-92	118,953	0	68,169	50,784
Jan-93	122,282	0	69,427	52,855
Feb-93	109,904	0	65,687	44,217
Mar-93	120,057	1,403	72,596	48,864
Apr-93	110,720	5,419	79,246	36,893
Tot/Avg	825,398	9,334	496,577	338,155
Year Trend	1,414,968	16,001	851,275	579,694
May-93	99,756	38,054	69,799	68,011
Jun-93	135,120	1,285	83,781	52,624
Jul-93	151,487	1,275	96,256	56,506
Aug-93	147,326	9,560	92,704	64,182
Sep-93	127,102	3,364	92,890	37,576
Oct-93	125,152	1,474	98,186	28,440
Nov-93	113,285	2,931	60,820	55,396
Dec-93	93,620	31,823	44,906	80,537
Jan-94	122,440	1,792	75,576	48,656
Feb-94	98,171	13,964	79,507	32,628
Mar-94	112,145	1,431	81,742	31,834
Apr-94	100,743	29,007	75,016	54,734
Tot/Avg	1,426,347	135,960	951,183	611,124
May-94	109,725	41,792	76,376	75,141
Jun-94	136,925	11,686	86,291	62,320
Jul-94	126,581	16,540	85,298	57,823
Aug-94	124,717	12,195	88,392	48,520
Sep-94	117,337	4,671	77,505	44,503
Oct-94	100,759	3,836	79,717	24,878
Nov-94	105,194	689	69,639	36,244
Dec-94	108,345	587	79,157	29,775
Jan-95	110,540	0	74,765	35,775
Feb-95	87,394	15,570	75,562	27,402
Mar-95	99,863	12,050	82,234	29,679
Apr-95	78,668	39,295	78,594	39,369
Tot/Avg	1,306,048	158,911	953,530	511,429
2 Yr. Avg.	**1,366,198**	**147,436**	**952,357**	**561,277**

Figures taken from monthly operating logs - Water Treatment Plant

For Period Oct-93 to Sep-94:

Surface Water:	1,380,841
Well Water:	169,306
Total Produced:	1,550,147
Furnished to Elemendorf:	929,615
Total Consumed @ Ft. Richardson:	**620,532**

EXCAVATIONS SUMMER 94

ESTIMATED START DATE	ESTIMATED DAYS	WORK NUMBER	DESCRIPTION OF WORK	WAGNER	STATUS MECH
COMPLETE	3	OPN200584R	INSTALL 120 FEET DRIP, BRYANT FIELD		COMPLETE
COMPLETE	2	OPN206384R	RPL 10 INCH WATER VALVE, SOUTH 804		COMPLETE
COMPLETE	2	OPN113024R	RPL 8" WATER VALVE S.W. BLDG 920		COMPLETE
COMPLETE	2	OPN150374R	RPR 20" BELL JOINT LEAK BY BOUNDRY	X	COMPLETE
COMPLETE	2	OPN113044R	RPL 8" WATER VALVE NW BLDG 974		COMPLETE
COMPLETE	2	OPN150494R	RPR FRP LEAK BY DOG KENNEL		COMPLETE
COMPLETE	5	XB 002707P	RPL 20", 14", & 12" VALVE BY CH&PP		COMPLETE
COMPLETE	2	OPN192344R	RPR WATER BREAK BY 932	X	COMPLETE
COMPLETE		OPN193094R	RPR WATER BREAK TOTMAN ROAD	X	COMPLETE
COMPLETE	2	OPN182934R	RPR FRP LEAK , EAST OF BLDG 618		COMPLETE
COMPLETE		OPN192354R	RPR WATER BREAK DAVIS HYWAY, ARMORY	X	COMPLETE
COMPLETE	5	OPN000074J	RPR FRP BREAK BY BLDG 740		COMPLETE
COMPLETE	1	DPW188474R	CAP OFF 1" NAT GAS 1ST & D, CONNECT BY ENTOM		COMPLETE
COMPLETE	5	DPW169334R	RPL HYDRANT AND SERVICE TAP BLDG 733		COMPLETE
COMPLETE	20	OPN000282J	RPL CONDENSATE "A" ST BETWEEN 5TH & 6TH		COMPLETE
COMPLETE	4	OPN150484R	RPR TWO FRP BREAKS, BRYANT FIELD		COMPLETE
COMPLETE	15	OPN000053J	RPL CONDENSATE BY BLDG 690		COMPLETE
COMPLETE	15	TF 000149P	RPL CONDENSATE LINE ON KENAI		COMPLETE
COMPLETE	2	OPN155404R	RPR WATER BREAK WEST OF BLDG 618	X	COMPLETE
COMPLETE	2	AFH000174J	RMV WATER SERVICE TO BLDG 240		COMPLETE
COMPLETE	2	AFH000174J	RMV WATER SERVICE TO BLDG 246		COMPLETE
COMPLETE	3	AFH000174J	RMV WATER & STM "T" SERVICE TO BLDG 507		COMPLETE
COMPLETE	3	AFH000174J	RMV WATER & STM "T" SERVICE TO BLDG 502		COMPLETE
COMPLETE	3	AFH256532R	RPL HYDRANT BY BLDG 103		COMPLETE
COMPLETE	3	AFH256552R	RPL HYDRANT BY BLDG 120		COMPLETE
COMPLETE	2	OPN086154R	RPR WATER BREAK BY BLDG 45590	X	COMPLETE
COMPLETE	2	OPN133314R	RMV SIDEWALK, EXCAVATE & RMV PLATE		COMPLETE
COMPLETE	1	OPN135284R	RPL EIGHT INCH VALVE TOTUM RD, ABOVE 45590		COMPLETE
COMPLETE	2	OPN136984R	RPR RETURN FROM CHAPEL		COMPLETE
COMPLETE	2	RP 105894R	RMV SERVICE, EAST SIDE BLDG 690, FIRE POINT		COMPLETE

PUBLIC WORKS ALASKA

MECHANICAL SECTION EXCAVATIONS SUMMER 95

ESTIMATED START DATE	EST DAYS	WORK #	FACILITY #	DESCRIPTION OF WORK	BASE	STATUS MECH
1-Jun-95	1	OPN14399/5R	WATRC	RPR WATER BREAK CEMETARY	X	READY
5-Jun-95	20	AFH 4/4J	STMCB	RPL HEADER TWO, ARTIC VALLEY RD		READY
10-Jul-95	2	ERM 16/4J	908	RMV PIV & WATER, CAP BOTH ENDS NGAS, BLDG 908		HLD
COMPLETE	2	ERM 6/5J	762	RMV WATER, TMP GAS STATION		COMP
COMPLETE	2	DPW13834/5R	WATRA	RPR 20 INCH MAIN BREAK AT 5TH AND ARTIC	X	COMP
COMPLETE	3	AFH116405R	STMCB	RPR FRP LEAK OUTSIDE PIT 208G, BY BLDG 304		COMP
COMPLETE	1	DPW13835/5R	WATRA	RPR WATER BREAK TO MAIN GATE	X	COMP
COMPLETE	1	ERM43/4J	45590	RMV WATER SERVICE		COMP
COMPLETE	1	OPN137555R	WATRC	FROZEN WATER LINE TO CEMETARY		COMP
COMPLETE	2	ERM 43/4J	45590	RMV GAS TO PROF AUTO, ABANDON GAS TO 908		COMP
COMPLETE	2	AFH 6/5J	402	CAP WATER SERVICE		COMP
COMPLETE	2	AFH 6/5J	402	CAP STEAM & CONDENSATE		COMP
COMPLETE	2	AFH 6/5J	407	CAP WATER SERVICE		COMP
COMPLETE	1	AFH 6/5J	407	CAP STEAM & CONDENSATE		COMP
COMPLETE	1	AFH 6/5J	400	RMV WATER & STM SERVICE		COMP
COMPLETE	2	AFH12235/5R	WATRB	RPR BROKEN SERVICE BLDG 293 & RPR IRRIGATION	X	COMP
COMPLETE	2	ERM 5/5J	712	REMOVE WATER SERVICE		COMP
COMPLETE	5	OPN094545R	STMCA	INSPECT FOR LEAK, INSULATE GROUND BLDG 1		COMP
	2	DPW131065R	WATRA	BLDG 656, BALLFIELD WATER HYDRANT		MAT ORDERED
	5	ERM 28/4J	296	RMV WATER & STM SERVICE, BOY SCOUT, INSTALL 14" VALVE		SUP
	3	ERM 7/5J	736	RMV WATER BLDG, CORP OFFICE (GAS ENSTAR)		ADE
	2	ERM 34/5J	932	RMV PIV		H$$
	2	ERM 35/4J	934	RMV PIV (NO FIRE PROTECTION)		H$$
	2	ERM 36/4J	936	RMV PIV		H$$
	2	ERM 37/4J	944	RMV PIV		H$$
	2	ERM 40/4J	972	RMV PIV		H$$
	3	ERM 8/5J	45040	RMV GAS & WATER, BOAT RPR		SHP
	2	ERM 44/4J	47461	RMV WATER SERVICE & PIV, FLY CLUB		H$$
	4	OPN 155/7P	WATRF	INSTALL HYDRANT ON 20", GOLF COURSE		SUP

POPULATION SERVED
CURRENT vs PROJECTED

DEMOGRAPHICS (Includes Tenants)	CURRENT 1993 ALASKA	CURRENT 1993 FRA	CURRENT 1993 FWA	CURRENT 1993 FGA	PROJECTED By End of FY 94 ALASKA	PROJECTED By End of FY 94 FRA	PROJECTED By End of FY 94 FWA	PROJECTED By End of FY 94 FGA
TOTAL POPULATION SERVED								
MILITARY	10,896	5,078	5,380	438	8,280	3,117	4,716	447
FAMILY MEMBERS	16,633	8,077	7,741	815	13,232	5,584	6,817	831
CIVILIANS (EMPLOYED)	4,224	1,749	2,045	430	4,278	1,776	2,072	430
RETIREES (ARMY)	1,929	1,350	476	103	1,929	1,350	476	103
TOTAL	33,682	16,254	15,642	1,786	27,719	11,827	14,081	1,811
PERMANENT PARTY		Auth as of Sep 92				Auth as of May 94		
MILITARY (ACTIVE)	9,824	4,396	5,003	425	7,208	2,435	4,339	434
FAMILY MEMBERS	12,956	5,575	6,709	672	9,555	3,082	5,785	688
CIVILIANS (DoD)	4,042	1,680	1,959	403	4,096	1,707	1,966	403
RETIREES (Army)	1,852	1,345	407	100	1,852	1,345	407	100
FAMILY MEMBERS	2,408	1,749	529	130	2,408	1,749	529	130
TOTAL	31,082	14,745	14,607	1,730	25,119	10,318	13,046	1,755
TRANSIENT PERSONNEL		Actual Status as of Sep 92				Negligible Change Anticipated		
MILITARY	1,072	682	377	13	1,072	682	377	13
CIVILIANS (DoD)	182	69	86	27	182	69	86	27
RETIREES (Army)	77	5	69	3	77	5	69	3
FAMILY MEMBERS	1,269	753	503	13	1,269	753	503	13
TOTAL	2,600	1,509	1,035	56	2,600	1,509	1,035	56
RESIDING ON-POST		Actual Status as of Sep 92				Est. based on Stationing Plan & Housing Assets		
MILITARY ON-POST	7,008	2,892	3,692	424	6,551	2,435	3,692	424
FAMILY MEMBERS	9,470	3,891	4,917	662	8,091	3,280	4,143	668
TOTAL	16,478	6,783	8,609	1,086	14,642	5,715	7,835	1,092
RESIDING OFF-POST		Actual Status as of Sep 92				Est. based on Stationing Plan & Housing Assets		
MILITARY OFF-POST	2,643	1,517	1,123	3	982	0	979	3
FAMILY MEMBERS	3,486	1,684	1,792	10	1,564	0	1,554	10
TOTAL	6,129	3,201	2,915	13	2,546	0	2,533	13

B-22

STATISTICAL DATA

AS OF SEPTEMBER 30, 1994

	FRA	FWA	FGA	OTHER	TOTAL
GROUNDS (Thousands of Acres)	**62**	**916**	**662**	**3**	**1,643**
Training Acres	47	878	629	3	1,557
BUILDINGS (Millions of Sq Ft)	**7.6**	**8.9**	**1.7**	**.4**	**18.6**
MILITARY AUTHORIZED	**2,175**	**4,490**	**390**		**7,055**
1st Bde, 6th ID (L)	1,082	2,561			3,643
Echelons Above Brigade (EAB)	372	1,048			1,420
US Army Garrison (USAG)	448	398	182		1,028
Tenants	273	483	208		964
FAMILY MEMBERS (ACTIVE DUTY)	**3,818**	**6,301**	**612**		**10,731**
ARMY RETIREES	**1,271**	**466**	**101**	**85**	**1,923**
Family Members	1,652	606	131	111	2,500
CIVILIAN EMPLOYEES (ACTUAL)	**1,046**	**739**	**221**		**2,006**
DA Garrison	875	533	169		1,577
DA & DOD Tenants	171	206	52		429
OTHER CIVILIAN EMPLOYEES	**535**	**914**	**147**		**1,596**
Defense Commissary Agency	56	55	21		132
AAFES	114	266	30		410
DFAS	45	4			49
NAF	170	158	46		374
BLM		306			306
Employees of Contractors	150	125	50		325
SCHOOLS ON POST	**3**	**2**	**1**		**6**
Student Enrollment	808	711	331		1,650
FAMILY QUARTERS (UNITS)	**1,725**	**1,619**	**321**		**3,665**
Officer	180	250	50		480
Enlisted	1,545	1,369	271		3,185
801 LEASED HOUSING (UNITS)		**550**			**550**
Officer		116			116
Enlisted		434			434
TOTAL EXPENDITURES (Millions)	**$247.2**	**$316.5**	**$41.2**		**$604.9**
FY 94 PAYROLL	**$170.2**	**$189.6**	**$23.1**		**$382.9**
Military Active Duty	101.8	143.7	8.7		254.2
Army Reserve	.8	.3			1.1
Civilian Garrison	50.5	27.5	8.6		86.6
Civilian Tenants	9.1	8.6	3.7		21.4
Defense Commissary Agency	2.4	2.3	.9		5.6
AAFES	2.2	5.0	.6		7.8
NAF	3.4	2.2	.6		6.2
FY 94 OTHER EXPENDITURES	**$77.0**	**$126.9**	**$18.1**		**$222.0**
NAF Procurement	1.6	1.0	.3		2.9
Supplies & Equipment	20.6	27.9	6.0		54.5
Other Operational Costs	50.3	80.0	10.7		141.0
Military Construction	4.5	18.0	1.1		23.6

6th Infantry Division (Light) & US Army Garrison, Alaska transitioned to US Army Alaska (USARAK) in FY 94.

Directorate of Resource Management
DSN (317) COM'L (907) 384-2032/2320

UNITED STATES ARMY ALASKA (USARAK)
INSTALLATION POPULATION PROFILE
FISCAL YEAR ENDING 30 SEP 1994

DATE: 12/14/94

MILITARY ACTIVE DUTY STRENGTH

	TOTAL	TOTAL	FT. RICHARDSON		FT. WAINWRIGHT		FT. GREELY	
1st BDE, 6ID (L) & USAG, AK	AUTH	ASSIGN	AUTH	ASSIGN	AUTH	ASSIGN	AUTH	ASSIGN
1st BDE, 6ID (L)	3,643	3,874	1,082	1,220	2,561	2,654	0	0
ECH ABOVE BDE (EAB)	1,420	1,380	372	350	1,048	1,030	0	0
TOTAL MTOE	5,063	5,254	1,454	1,570	3,609	3,684	0	0
USAG, AK INCLUDING LEC (TDA)	1,028	1,318	448	687	398	443	182	188
TOTAL HOST	6,091	6,572	1,902	2,257	4,007	4,127	182	188
MILITARY TENANTS								
NCO ACADEMY (CADRE)	34	30	34	30	0	0	0	0
500 MI BDE INSCOM AK	2	3	2	3	0	0	0	0
CID	19	15	12	9	7	6	0	0
59TH SIG BN	119	136	74	87	27	30	18	19
NWTC (CADRE)	63	65	0	0	0	0	63	65
CRTC	79	74	1	1	0	0	78	73
MEDDAC	405	467	37	65	337	365	31	37
DENTAC	73	79	23	27	43	46	7	6
MTMC	1	1	1	1	0	0	0	0
MEPS ANCHORAGE STATION	6	6	6	6	0	0	0	0
TRIAL DEFENSE	4	4	2	2	2	2	0	0
AF PACIFIC BROADCAST	5	5	0	0	0	0	5	5
95TH CS CO (TMDE)	15	12	0	0	9	8	6	4
LAO	2	2	0	1	2	1	0	0
CRREL	2	1	0	0	2	1	0	0
AK DIST OFC COE	7	7	3	3	4	4	0	0
DEFENSE ACCTG OFC (DAO)	34	43	18	23	12	13	4	7
SENIOR ARMY ADVISOR	35	26	35	26	0	0	0	0
RESERVE COMP SPT GP	2	2	2	2	0	0	0	0
USA EAFB DEF COURIER	5	5	5	5	0	0	0	0
USA FORCES (ALCOM)	17	16	17	16	0	0	0	0
DARR ALASKA REGION	1	1	1	1	0	0	0	0
3RD ASOS-AIRFORCE	50	49	0	0	50	49	0	0
TOTAL TENANT	980	1,049	273	308	495	525	212	216
INSTALLATION TOTAL	7,071	7,621	2,175	2,565	4,502	4,652	394	404

1st BDE, 6th ID (L), EAB, Garrison, & Tenants Data Source: SIDPERS C-61 Year End Strength Report and input provided by tenants not included in the C61 Report.

Installation assigned strength is accurate within plus or minus three percent due to transient nature/lag time associated with in/out processing of active duty military personnel.

Information contained in this report is to be used during FY95 to report the current population for the installation.

Prepared by DRM, Programming & Cost Analysis Branch, DSN (317) 384-2032/2320.

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CIVILIAN EMPLOYEE STRENGTH

	TOTAL AUTH	TOTAL ACTUAL	FT. RICHARDSON AUTH	FT. RICHARDSON ACTUAL	FT. WAINWRIGHT AUTH	FT. WAINWRIGHT ACTUAL	FT. GREELY AUTH	FT. GREELY ACTUAL
CIVILIAN HOST								
US ARMY GARRISON, AK	1,472	1,577	828	875	475	533	169	169
TOTAL HOST	**1,472**	**1,577**	**828**	**875**	**475**	**533**	**169**	**169**
CIVILIAN TENANTS								
NCO ACADEMY (CADRE)	1	1	1	1	0	0	0	0
CID	3	3	2	2	1	1	0	0
59TH SIG BN	106	104	83	81	18	19	5	4
NWTC (CADRE)	10	8	0	0	0	0	10	8
CRTC	35	38	0	0	0	0	35	38
MEDDAC	162	120	8	10	148	109	6	1
DENTAC	11	11	5	5	5	5	1	1
MTMC	4	4	4	4	0	0	0	0
MEPS ANCHORAGE STA	11	11	11	11	0	0	0	0
95TH CS CO (TMDE)	0	1	0	0	0	1	0	0
LAO	10	10	1	1	9	9	0	0
CRREL	10	12	0	0	10	12	0	0
CORPS OF ENGR	81	81	43	43	38	38	0	0
DEFENSE ACCTG OFC (DAO)	52	49	48	45	4	4	0	0
SENIOR ARMY ADVISOR	1	1	1	1	0	0	0	0
USAR TECHNICIAN	11	12	9	9	2	3	0	0
COMMISSARY (DECA)	146	132	64	56	62	55	20	21
DRMO	9	9	0	0	9	9	0	0
DA INTERNS	3	3	3	3	0	0	0	0
AAFES	457	410	114	114	304	266	39	30
CONTRACTORS EMPLOYEES	325	325	150	150	125	125	50	50
*BLM	450	306	0	0	450	306	0	0
*NAF	496	374	220	170	213	158	63	46
TOTAL TENANTS	**2,394**	**2,025**	**767**	**706**	**1,398**	**1,120**	**229**	**199**
INSTALLATION TOTAL	**3,866**	**3,602**	**1,595**	**1,581**	**1,873**	**1,653**	**398**	**368**

Host & Tenant Data Source: DRM, Manpower, Equipment, & Documentation Division (MEDD) and input provided by tenants.

* BLM & NAF assigned strengths are seasonal in nature and vary significantly during the year.

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UNITED STATES ARMY ALASKA (USARAK)
INSTALLATION POPULATION PROFILE
FISCAL YEAR ENDING 30 SEP 1994

DATE: 12/14/94

OTHER DEMOGRAPHIC DATA

	FT. RICHARDSON	FT. WAINWRIGHT	FT. GREELY	OTHER
MILITARY RETIREES				
ARMY	1,327	461	99	82
OTHER DOD	3,595	637	175	99
ARMY FAMILY MEMBERS	1,725	599	129	107
OTHER DOD FAMILY MEMBERS	4,674	828	228	129
SUBTOTAL	11,321	2,525	631	417
MILITARY & CIVILIANS ON POST				
RESIDING IN FAMILY QUARTERS	1,321	1,930	252	0
RESIDING IN BARRACKS	578	1,620	140	0
CIVILIANS RESIDING ON POST	1	1	0	0
OTHER MILITARY RESIDING ON POST	35	8	1	0
SUBTOTAL	1,935	3,559	393	0
MILITARY OFF POST				
MARRIED	666	935	5	0
SINGLE AND/OR UNACCOMPANIED	0	154	0	0
SUBTOTAL	666	1,089	5	0
TRANSIENT QUARTERS				
RETIREES	13	71	2	0
FAMILY MEMBERS	658	372	52	0
CIVILIAN (ARMY)	94	135	58	0
MILITARY (DOD)	757	368	59	0
SUBTOTAL	1,522	946	171	0
FAMILY MEMBERS				
ON POST (ARMY)	2,995	4,752	596	0
ON POST (OTHER MILITARY)	79	24	3	0
ON POST (DA CIVILIAN)	2	2	0	0
OFF POST (ARMY)	823	1,549	16	0
SUBTOTAL	3,899	6,327	615	0
INSTALLATION TOTAL	19,343	14,446	1,815	417

Military Retirees Data Source: Retirement Services Office and the FY93 DOD Statistical Report on the Military Retirement System.

Military, Civilian, and Family Members Housing Data Source: DPW Housing Performance Reports.

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UNITED STATES ARMY ALASKA (USARAK)
INSTALLATION POPULATION PROFILE
FISCAL YEAR ENDING 30 SEP 1994

DATE: 12/14/94

OTHER DEMOGRAPHIC DATA

	ELMENDORF AFB	EIELSON AFB	OTHER LOCATIONS	FORT RICHARDSON	FORT WAINWRIGHT	FORT GREELY
OTHER MILITARY						
ACTIVE DUTY AIR FORCE	6,791	2,785	586	0	49	0
ON BASE FAMILY MEMBERS (USAF)	3,801	2,812	0	0	0	0
OFF BASE FAMILY MEMBERS (USAF)	7,188	1,585	0	0	0	0
TOTAL	17,780	7,182	586	0	49	0
ALASKA ARMY NATIONAL GUARD	0	0	1,203	990	130	0
USAR 813TH ENGINEER BN	0	0	0	220	64	0
USAR 1984TH HOSPITAL	0	0	0	52	71	0
TOTAL	0	0	1,203	1,262	265	0

MILITARY SCHOOL TRAINING	TOTAL TRAINED	FORT RICHARDSON	FORT WAINWRIGHT	FORT GREELY
NORTHERN WARFARE TRAINING CENTER (NWTC)	1,124	0	0	1,124
NCO ACADEMY	612	612	0	0
TOTAL	1,736	612	0	1,124

CAMP CARROLL USAGE REPORT SERVICE COMPONENT	FY 94 MANDAYS
ACTIVE DUTY ARMY,USAR, ARNG	22,124
OTHER DOD AND NON-DOD	30,272
TOTAL	52,396

Military Training Data Source: Northern Warfare Training Center Center (NWTC), Ft. Greely, and the NCO Academy, Ft. Richardson.

Camp Carroll Data Source: Alaska Army National Guard Facilities Management Division, Camp Carroll.

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APPENDIX C

LEAK DETECTION SURVEY

Leak Detection Summary
1995 Leak Detection Report

LEAK DETECTION SURVEY - FT. RICHARDSON, AK

LEAK NO.	TYPE OF LEAK	WATER MAP	LOCATION/ DESCRIPTION	SIZE (GPD)	PIPE/VALVE SIZE
F3-1	Main Line	F-3	National Cemetary	72,000	4" Line
F3-2	Main Line	F-3	National Cemetary	36,000	4" Line
F3-3	Valve (Packing)	F-3	Randall Road @ Stambone Road	2,500	6" Valve
F3-4	Fire Hydrant	F-3	Hydrant #57-24, Stambone Road	1,000	
F3-5	Fire Hydrant	F-3	Hydrant #8-66, Near Bldg. #932	1,000	
F3-6	Fire Hydrant	F-3	Hydrant #57-1, Randall Road @ Davis Hwy.	1,000	
F4-1	Valve (Packing)	F-4	Davis Hwy @ VA Entrance	2,500	10" Valve
G2-1	Service Line	G-2	Bldg. #45070, Circle Drive	3,500	Leak located inside bldg.
G3-1	Main Line	G-3	Warehouse Street @ Bldg. #984	36,000	8" Line
G3-2	Main Line/Valve	G-3	1st Street @ D Street	36,000	14" Line
G3-3	Fire Hydrant	G-3	Hydrant #7-8, Near Bldg. #796	1,000	
G3-4	Valve (Packing)	G-3	2nd Street @ C Street, Near Bldg. #626	2,500	10" Valve
G3-5	Valve (Packing)	G-3	6th Street @ Akutan Ave, Near Bldg. #205	2,500	4" Valve
G3-6	Valve (Packing)	G-3	6th Street @ Beluga Ave, Near Bldg. #226	2,500	8" Valve
G3-7	Fire Hydrant	G-3	Hydrant #1-16, Near 105A Gulkana	1,000	
G3-8	Fire Hydrant	G-3	Hydrant #3-20, 5th Street @ Juneau Ave.	1,000	
G3-9	Main Line	G-3	Frontage Road @ Arctic Valley Road	36,000	14" Line

LEAK SUMMARY

Leak Type	No. of Leaks	Size (GPD)	Size (KGAL/YR)
Main Line	5	216,000	78,840
Service Line	1	3,500	1,278
Valve (Packing)	5	12,500	4,563
Fire Hydrant	6	6,000	2,190
Total	17	238,000	86,870

Assume service line leak, which was located in an inaccessible building, was simply a water faucet opened to protect the water distribution piping from freezing, not a leak. Total leakage in the distribution system was assumed to be 234,500 GPD (85,593 kGal/year).

M.E. SIMPSON Co., Inc.

P.O. Box 1995
Valparaiso, IN 46384

800/255-1521
Fax: 219/531-2444

Branch office:
Grayslake, IL

June 16, 1995

Mr. Michael Scholz, P.E.
Project Manager
EMC Engineers, Inc.
2750 S. Wadsworth Blvd.
Suite C-200
Denver, CO 80227

Dear Mr. Scholz,

M.E. Simpson Company is a professional & technical service company that offers Leak Survey Programs, Large Meter Testing and Repair Programs, Water Main Location, and Valve Exercising, Location and Computer Mapping Programs. These **"Professional Services"** offered by M. E. Simpson Company are designed to aid a utility in reducing unaccounted for water and recovering lost revenue.

M. E. Simpson Company is pleased to submit this report of our leak detection survey for the Fort Richardson Army Post. This survey addressed the Ft. Rich water distribution system, consisting of approximately 55 miles of water main. The report contains the results of our investigation that includes the following:

1. A LISTING OF THE MEETINGS HELD WITH FT. RICHARDSON PERSONNEL
2. A DESCRIPTION OF THE AREA SURVEYED.
3. METHODOLOGY OF THE SURVEY
4. A LIST OF LEAKS AND TYPE OF LEAK LOCATED.
5. GENERAL RECOMMENDATIONS BASED ON OUR INVESTIGATION.

LISTING OF THE MEETINGS HELD WITH FORT RICHARDSON PERSONNEL

M.E. Simpson Company personnel held numerous meetings with Ft. Richardson personnel to keep them updated on the progress of the leak survey. The following is a listing of the meetings, who was there, and what was discussed:

05/31/95 - Project briefing - Michael Scholz, EMC
John Van Arsdel, M.E. Simpson Company
Michael Simpson, M.E. Simpson Company
Randall Jacobs, CENPA.EN.TE.DM
Darron Wood, Mechanical / Public Works-Ft. Rich
Pat Oien, Engineering / Public Works-Ft. Rich
William Garnand, Water Plant / Public Works-Ft. Rich
Paul Knauff, Engineering / Public Works-Ft. Rich

05/31/95 - facility tour, conducted by Darron Wood - M. Simpson, J. Van Arsdel, and M. Scholz

05/31/95 - project briefing of leak at the National Cemetery - D. Wood, M. Simpson and J. Van Arsdel

06/01/95 - project briefing of area we were working in - D. Wood, M. Simpson, J. Van Arsdel and M. Scholz

06/02/95 - project briefing of leak at building #984 - D. Wood, M. Simpson, J. Van Arsdel, M. Scholz, P. Knauff and P.W. staff members

06/05/95 - project briefing of area we were working in - D. Wood, M. Simpson and J. Van Arsdel

06/06/95 - project briefing of area we were working in - D. Wood, M. Simpson and J. Van Arsdel

06/07/95 - project briefing, gave complete update and overview of everything that was surveyed and leaks found. Answered any questions pertaining to the project and made recommendations. Also discussed the cooperation of the "P.W.-Mechanical". The cooperation has been excellent. Darron Wood, Paul Knauff, Michael Simpson, John Van Arsdel and P.W. staff members.

DESCRIPTION OF THE AREA SURVEYED

Approximately 290,400 lineal feet was surveyed as part of the system investigation. This included all fire hydrants, all accessible mainline valves, and 20 services.

METHODOLOGY

M.E. Simpson Company used the **FLUID CONSERVATION SYSTEMS S20** listening device along with the **MP90** preamplifier-transducer system to conduct your survey. Our experienced technicians used these devices as listening equipment to survey the pipeline network. Each hydrant, and accessible valves were used as listening points to identify leaks. Service, b-boxes, (20) were used to keep the listening distances under four hundred fifty feet (450'). **"Pin-Pointing"** of the leak, as well as locating leaks that other methods failed to reveal was done with the **90/90** and or **C2000 LEAK CORRELATORS,** the latest state of the art leak computers. These electronic instruments are microprocessor units that measure the time it takes the sound of the leak to travel from the leak to the point where the leak correlator is connected to the water line. By connecting the leak correlator to the water line at two locations, it will compute the distance from the leak to each connection point thus enabling us to determine the exact leak location. The results of the leak survey, including an estimate of water loss for the leaks identified, is documented in this report.

LEAKAGE LOCATED

All water mains within the project area were surveyed and seventeen leaks were located. There were five main line leaks, one service line leak, five valve leaks, and the balance fire hydrant leaks. All of these leaks have been verbally reported to your office with their location, so many have probably been repaired already. Following are the leak locations with an estimated GPD (Gallons Per Day) leakage potential:

TYPE	LOCATION	SIZE
Sec. - F3		
Main Line	National Cemetery (Leak # F3-1) see enclosed diagram **fixed**	72,000 GPD

TYPE	LOCATION	SIZE
Sec. - F3		
Main Line	National Cemetery (Leak # F3-2) see enclosed diagram	36,000 GPD
Valve (packing)	Randall Road at Stambone Road (Leak # F3-3) see enclosed diagram	2,500 GPD
Fire Hydrant	Hyd. #57-24, Stambone Road (Leak # F3-4) see enclosed diagram	1,000 GPD
Fire Hydrant	Hyd. #8-66 across from Bld. #932 (Leak # F3-5) see enclosed diagram	1,000 GPD
Fire Hydrant	Hyd. #57-1 Randall Road at Davis Hwy. (Leak # F3-6) see enclosed diagram	1,000 GPD
Sec. - F4		
Valve (packing)	Davis Hwy. at Entrance to Dept. of Military & Veterans Affairs (Leak # F4-1) see enclosed diagram	2,500 GPD
Sec. - G2		
Service Line	Bld. #45070 on Circle Drive (Leak # G2-1) see enclosed diagram	3,500 GPD
Sec. - G3		
Main Line	Warehouse Street at Bld. # 984 (Leak # G3-1) see enclosed diagram	36,000 GPD
Main Line/Valve	1st Street at D Street (Leak # G3-2) see enclosed diagram	36,000 GPD
Fire Hydrant	Hyd. #7-8 next to Bld. #796 (Leak # G3-3) see enclosed diagram	1,000 GPD
Valve (packing)	2nd Street at C Street next to Bld. #626 (Leak # G3-4) see enclosed diagram	2,500 GPD
Valve (packing)	6th Street at Akutan Avneue next to Bld. #205 (Leak # G3-5) see enclosed diagram	2,500 GPD
Valve (packing)	6th Street at Beluga Avenue next to Bld. #226 (Leak # G3-6) see enclosed diagram	2,500 GPD
Fire Hydrant	Hyd. #1-16 in front of 105A Gulkana (Leak # G3-7) see enclosed diagram	1,000 GPD

TYPE	LOCATION	SIZE
Sec. - G3		
Fire Hydrant	Hyd. #3-20 5th Street at Juneau Avenue (Leak # G3-8) see enclosed diagram	1,000 GPD
Main Line	Frontage Road at Arctic Valley Road (Leak # G3-9) see enclosed diagram	36,000 GPD
ESTIMATED LEAKAGE TOTAL		**238,000 GPD**

LEAK QUANTITIES

Quantifying leaks is difficult because there is not any accurate means of doing so. Pipe material, size of the leak, system pressure, soil material and water table will effect the noise that a leak makes. Small leaks under high system pressure will make more noise than a large leak under low system pressure. However, the above leaks are of sufficient noise levels that the above estimates should be very conservative. Using a production/maintenance price of $.7115 per thousand gallons, these leaks were costing your utility in excess of $169.00 per day or $61,685.00 annually. It obvious that this Leak Survey Program has proven to be very cost effective. Naturally the main line leaks have the greatest potential for loss followed by service line, valves, and finally hydrants. Once leaks have been repaired, we would recommend that the Utility compare pumping rates before and after. This information will be more meaningful and accurate.

RECOMMENDATIONS

This survey confirms that Ft. Rich's water distribution system will benefit from this project by a reduction in underground leakage. There is always a concern over the cost effectiveness of leak detection because of the uncertainty of the number of leaks located. However, with your present cost of water and the discovery of these seventeen leaks, the cost of this 1995 leak survey will pay for itself within 3 months. It only takes a recovery of about 56,000 gallons per day on an annual basis (56,000 gallons per day is only 38.8 gallons per minute throughout your entire water distribution system) to recover your investment. We would recommend that you conduct a Leak Survey Program every year. This recommendation becomes more critical as your cost of water increases.

During our survey we found the distribution system to be in excellent shape. The "mechanical" department has done an excellent job in this area. We would like to recommend a few changes that we feel would benefit Ft. Rich:

1) <u>All hydrants should be used by qualified personnel only.</u> The use of hydrants through-out the post should be limited to "mechanical" and emergency personnel **<u>only</u>**.

2) A single, designated fire hydrant should be selected for use by; street sweepers, tanker trucks, contractors and other related personnel. This hydrant should be located at or near building 700 so that the use can be monitored. Also, any person using the designated fire hydrant should be trained by "mechanical".

3) To prevent people from unauthorized use of the fire hydrants, hydrant locks should be installed! This practice will eliminate the damage done to the fire hydrants.

4) A hydrant numbering program and color coding program would be a great benefit to both the Fire Department and "Mechanical". This will aid "mechanical" when repairs have to be made to individual hydrants. By numbering them you can create a data base and track all pertinent information relating to that fire hydrant. By color coding the hydrants, you will benefit the fire department because they will know the line size and the approximate gallons per minute the hydrant can flow. This will also help "mechanical" & engineering in proper sizing of watermain and plot the hydraulic conditions of the water system.

We appreciate the cooperation of Mr. Wood, Mr. Knauff and their staff who were available to answer our questions during this project. If you have any questions with the information in this report, please do not hesitate to call.

Sincerely Yours,

Michael D. Simpson
Operations Manager

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

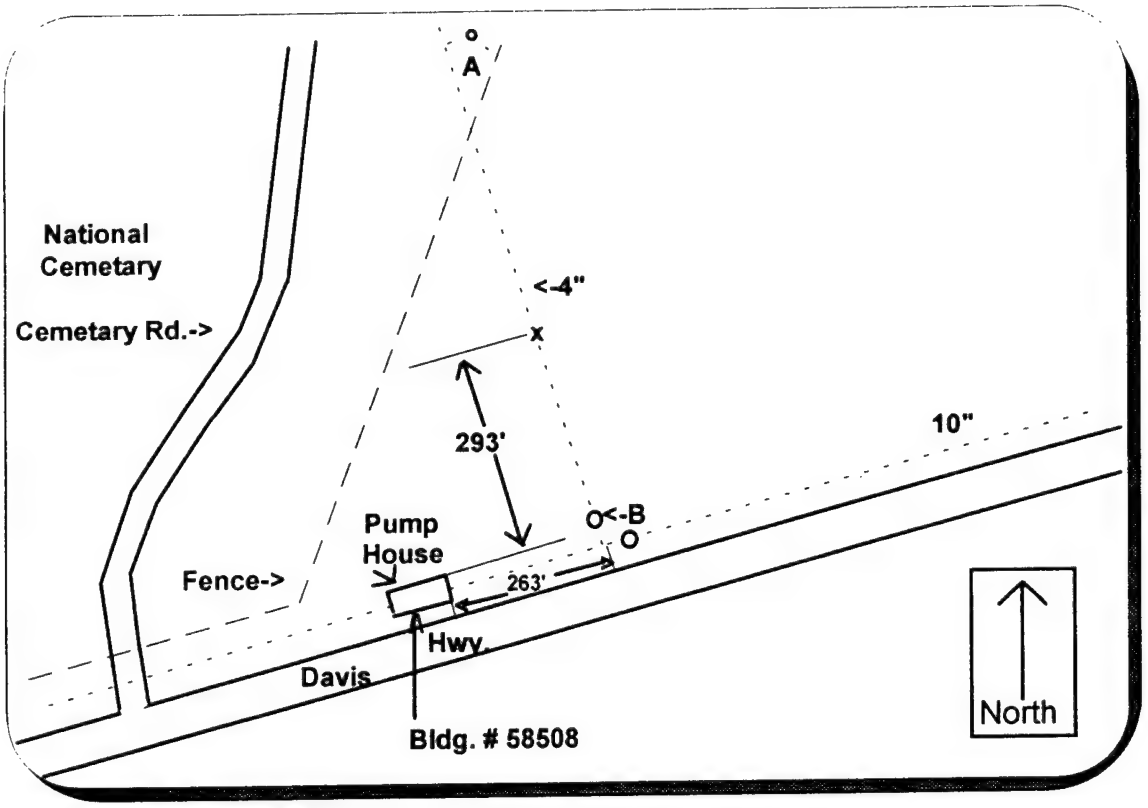
Client: Fort Richardson, AK

Time: Leak Survey

Date: May 31, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 717' from A to B

Connection point: A= Service (Hose Bib)
Connection point: B= 4" Valve

Leak Location: 438' from A
Dig Location: 438' from A

Comments: Leak # F3-1

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

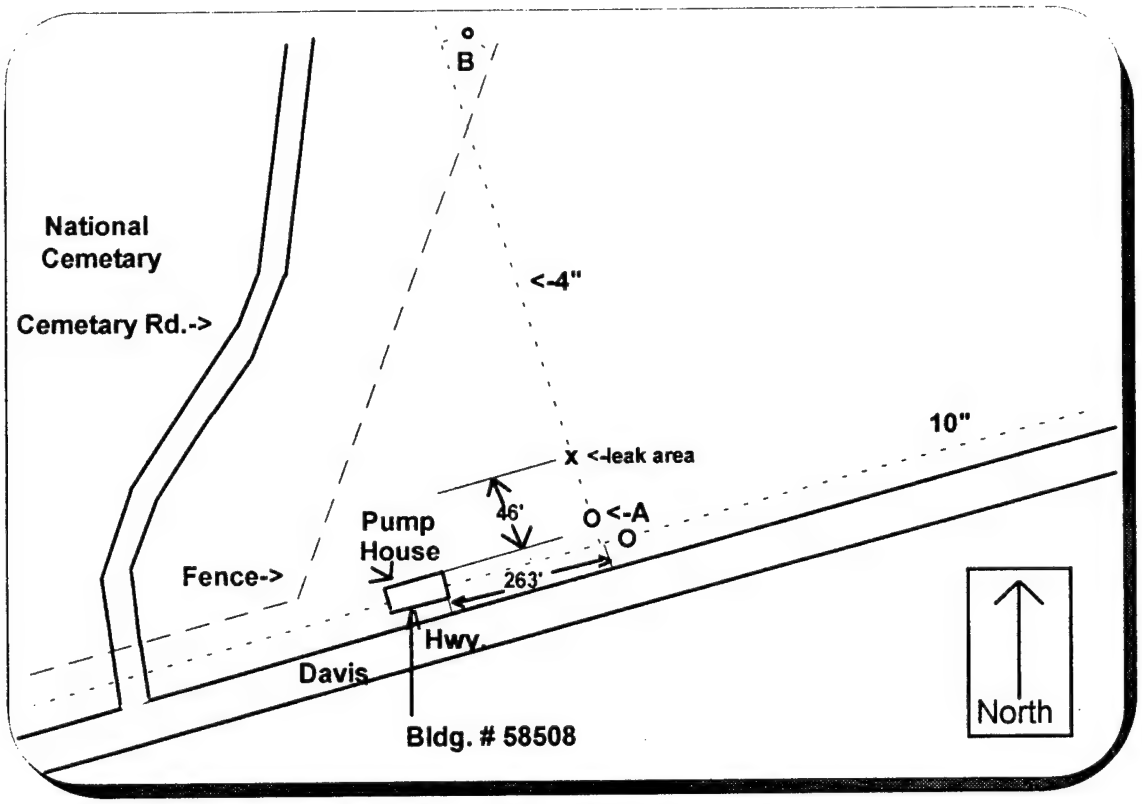
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 6, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 717' from A to B

Connection point: A= Valve
Connection point: B= Hose Bib

Leak Location: 32' from A
Dig Location: 32' from A

Comments: Leak # F3-2

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services
LEAK LOCATION REPORT

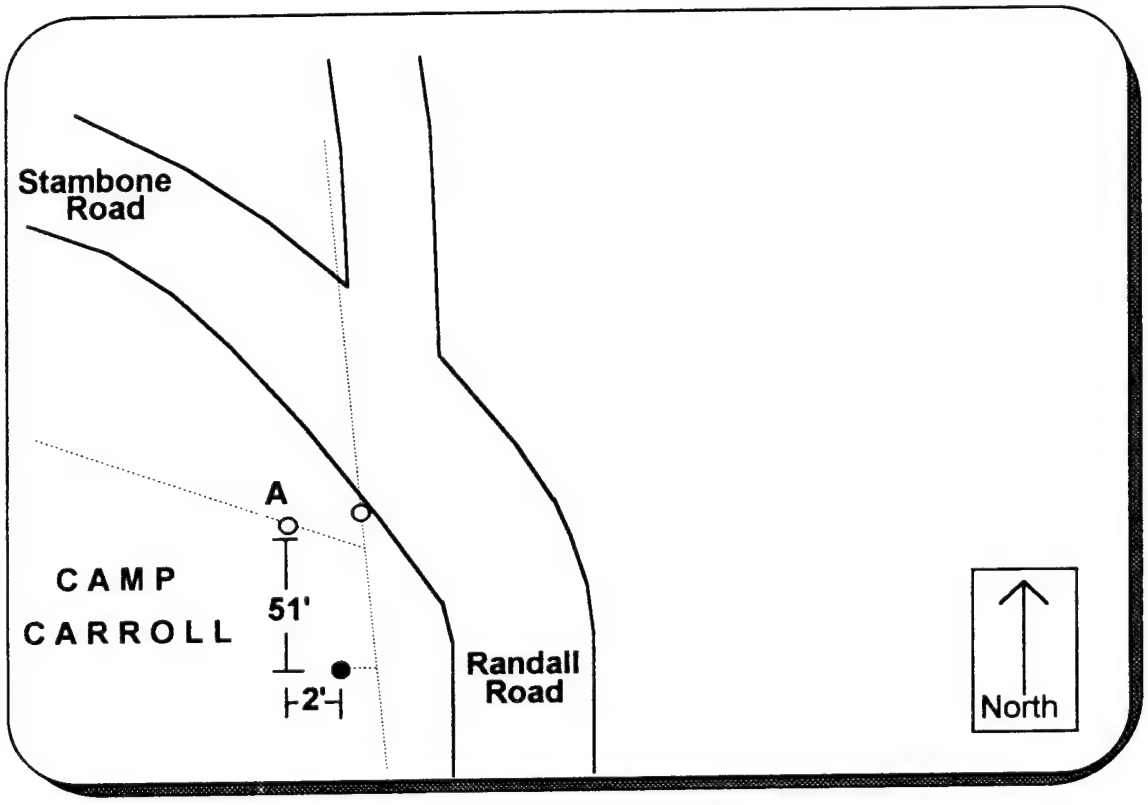
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 6, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Valve

Leak Location: 0' from A

Comments: This is a valve packing leak. Leak # F3-3

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

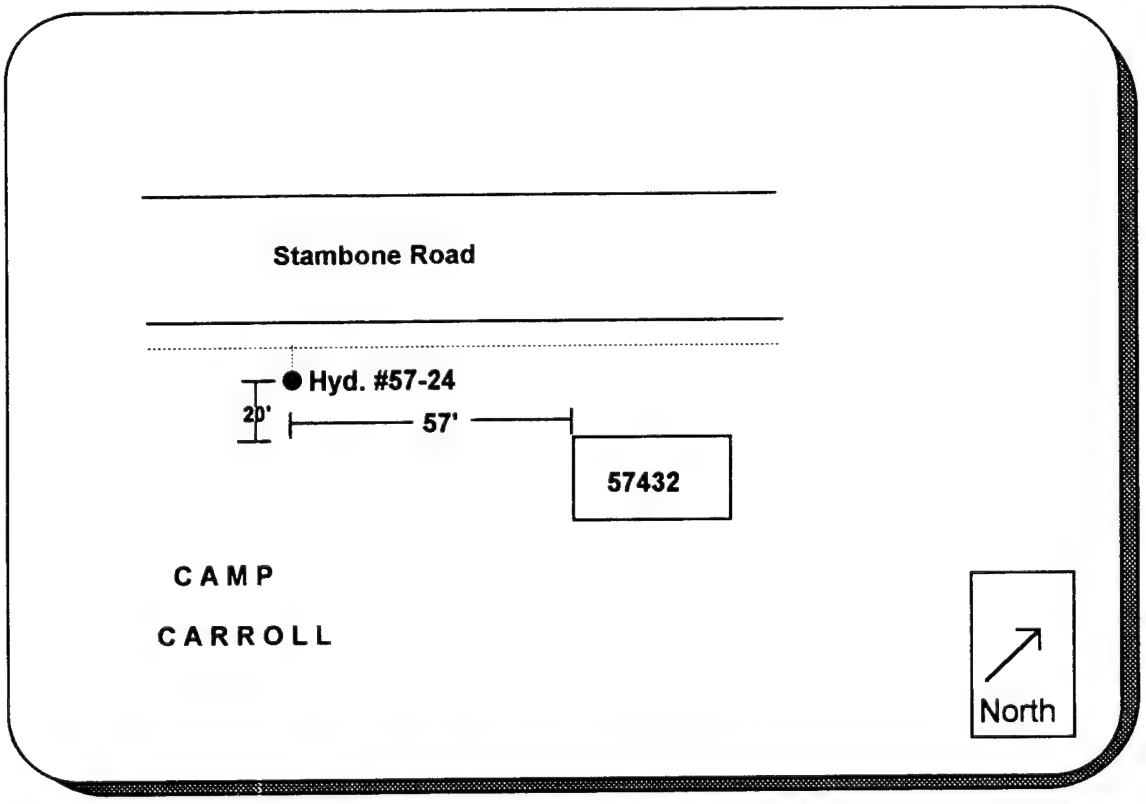
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 6, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Hydrant

Leak Location: 0' from A

Comments: This is a hydrant leak. Leak # F3-4

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services
LEAK LOCATION REPORT

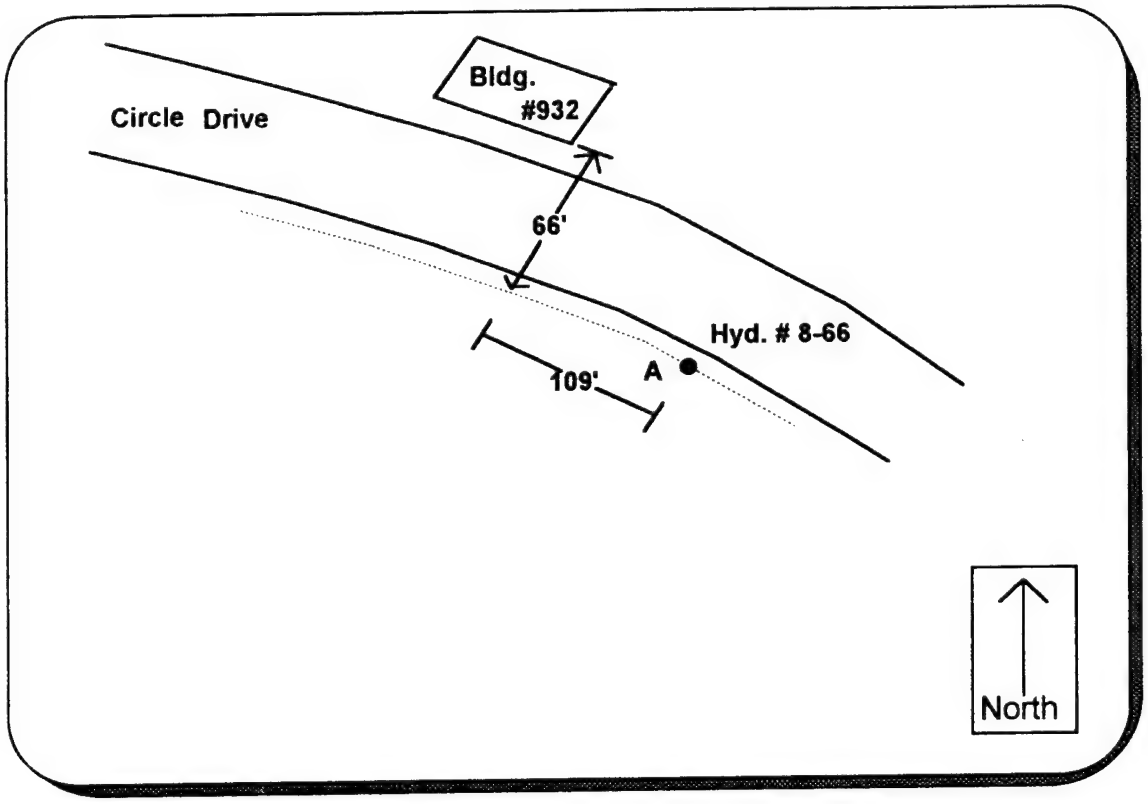
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Hydrant #8-66

Leak Location: 0' from A

Comments: This is a hydrant leak. The measurements were taken from the comer of the loading dock of Bldg. #932. Leak # F3-5

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

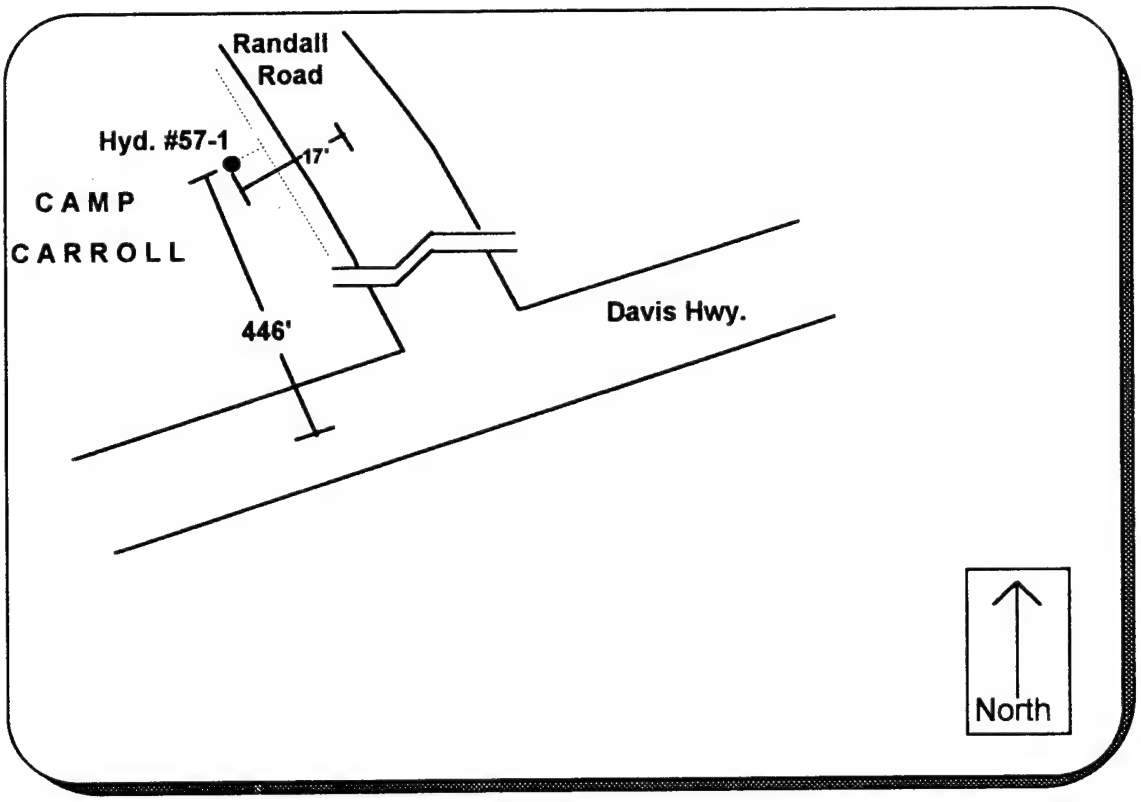
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Hydrant # 57-1

Leak Location: 0' from A

Comments: This is a hydrant leak. Leak # F3-6

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

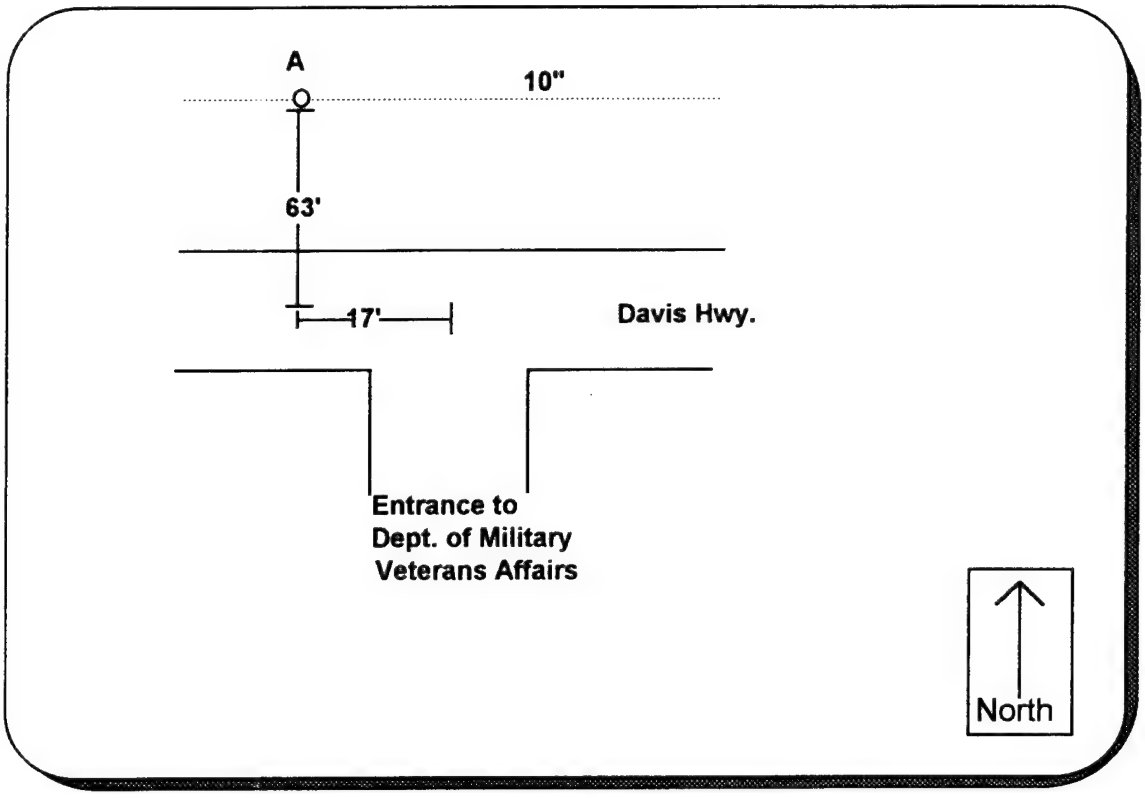
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Valve

Leak Location: 0' from A

Comments: This is a valve packing leak. Leak # F4-1

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

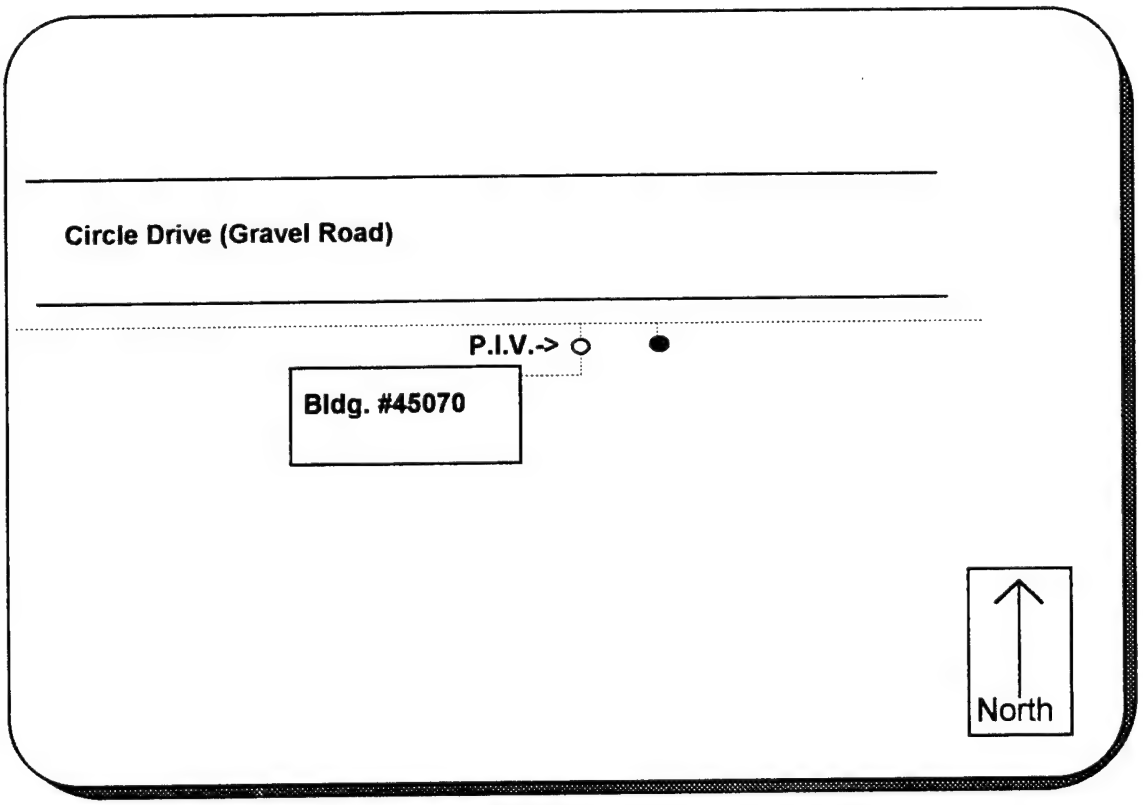
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance:

Connection point: A= P.I.V.

Leak Location: Inside Bldg. #45070

Comments: Can hear water running in building. Leak # G2-1

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services
LEAK LOCATION REPORT

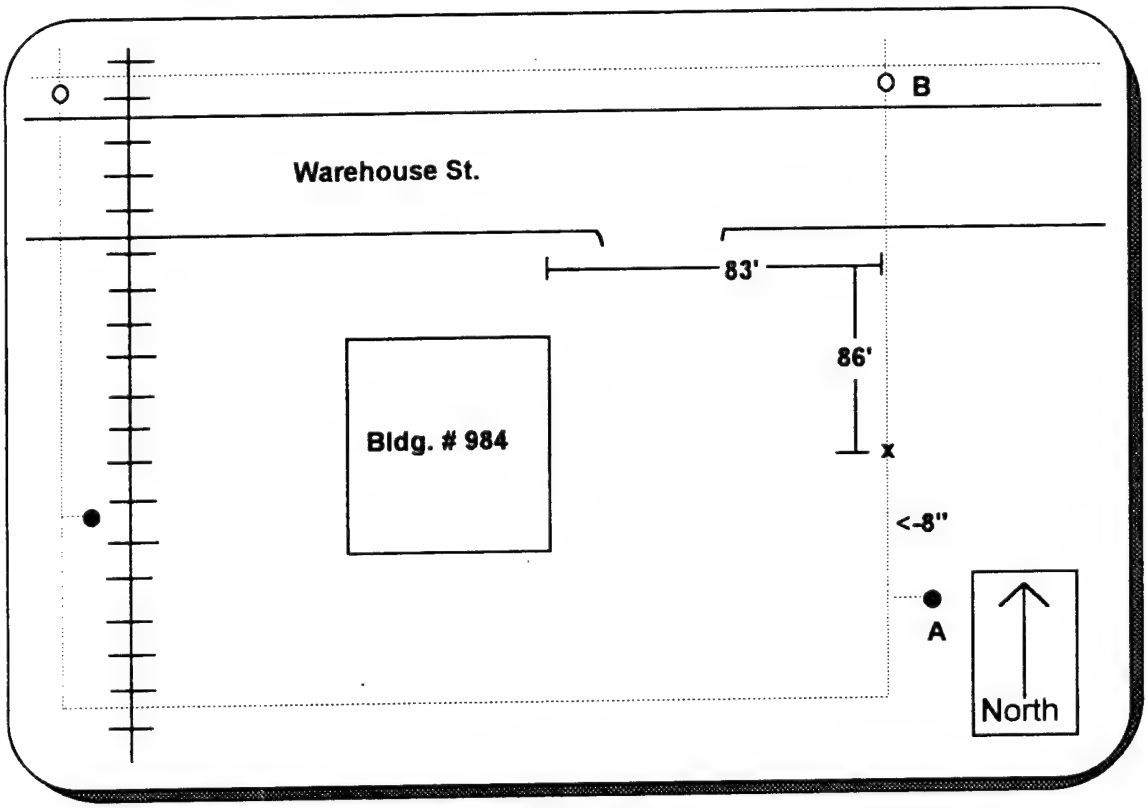
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 1, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 300' from A to B

Connection point: A= Hydrant
Connection point: B= Valve

Leak Location: 75' from A
Dig Location: 75' from A

Comments: Leak # G3-1

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

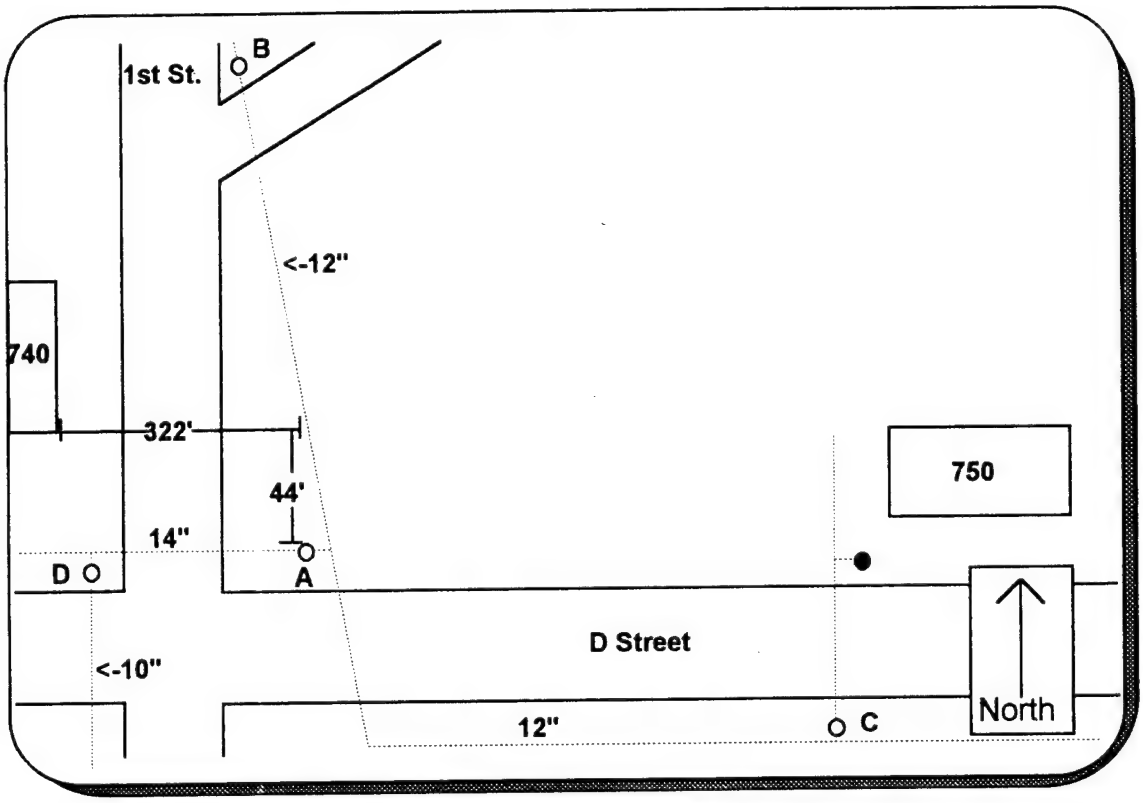
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 721' from A to B, 523' from A to C, 262' from A to D

Connection point: A= 14" Valve
Connection point: B= 12" Valve
Connection point: C= Valve
Connection point: D= 10" Valve

Leak Location: 0' from A
Dig Location: The valve marked "A" and the connecting "T".

Comments: Leak # G3-2

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

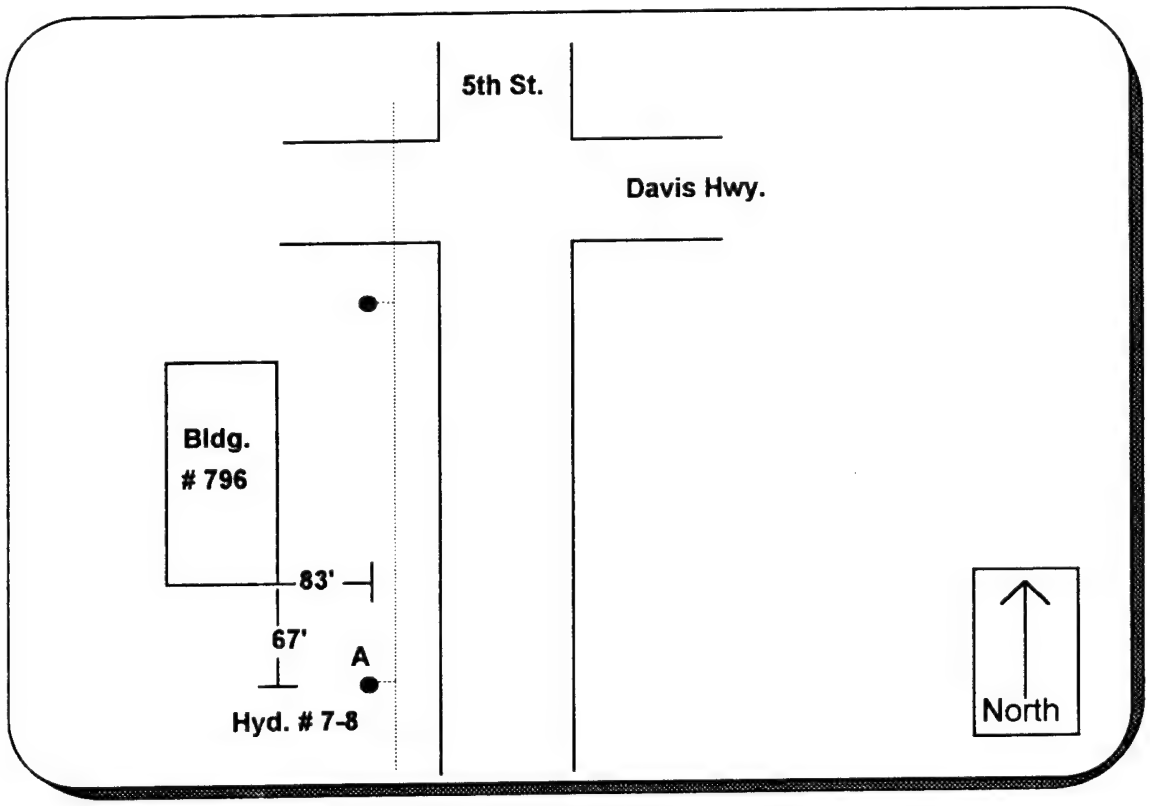
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 6, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Hydrant

Leak Location: Hydrant # 7-8
Dig Location:

Comments: This is a hydrant leak. Leak # G3-3

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

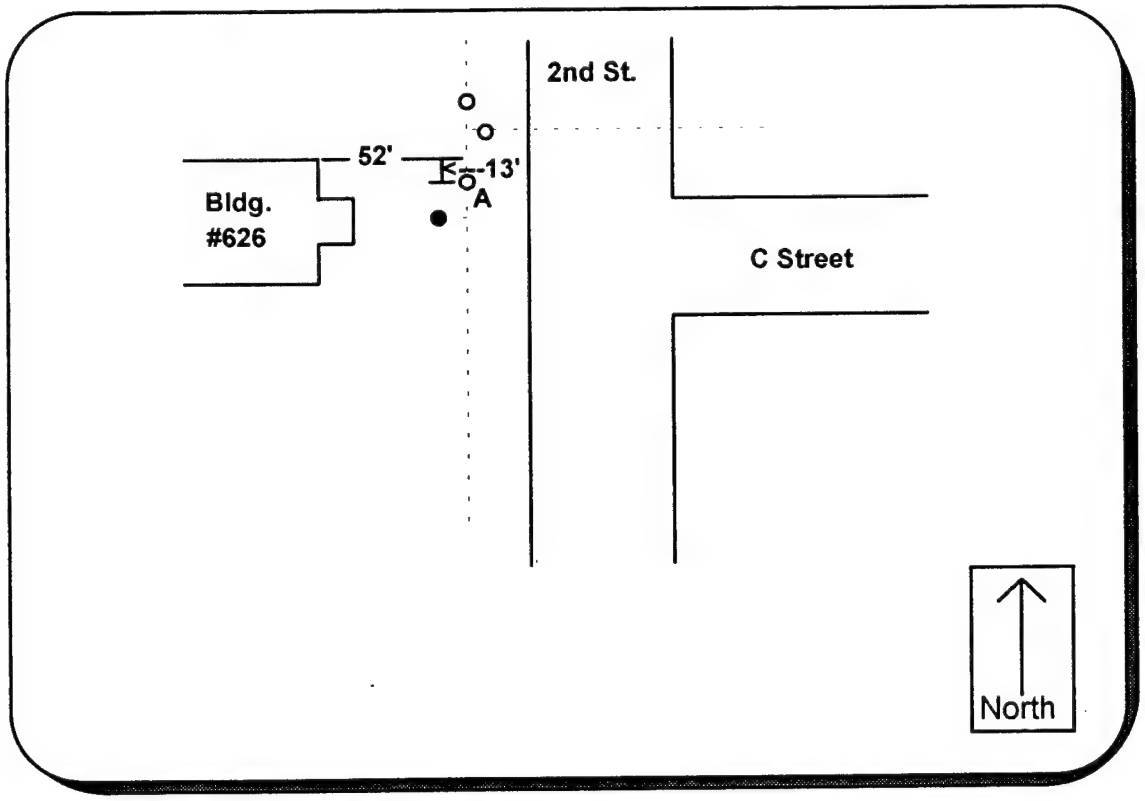
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Valve

Leak Location: 0' from A

Comments: This is a valve packing leak. Leak # G3-4

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

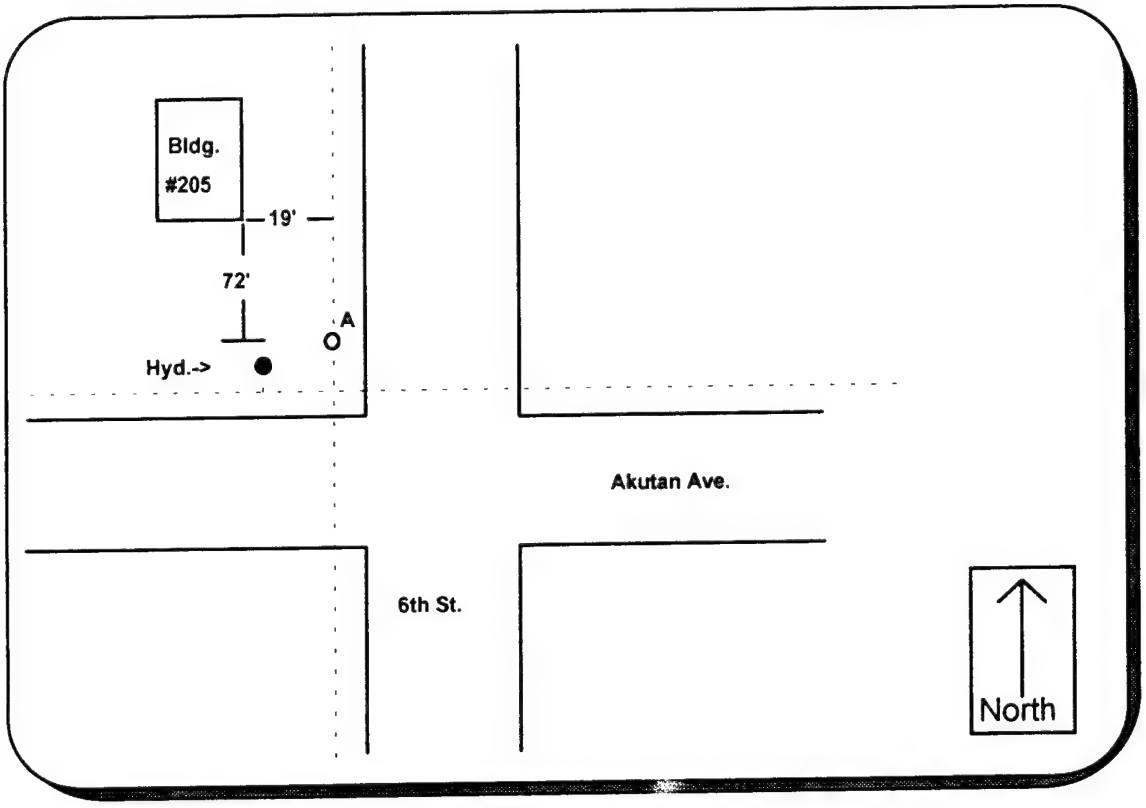
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Valve

Leak Location: 0' from A

Comments: This is a valve packing leak. Leak # G3-5

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

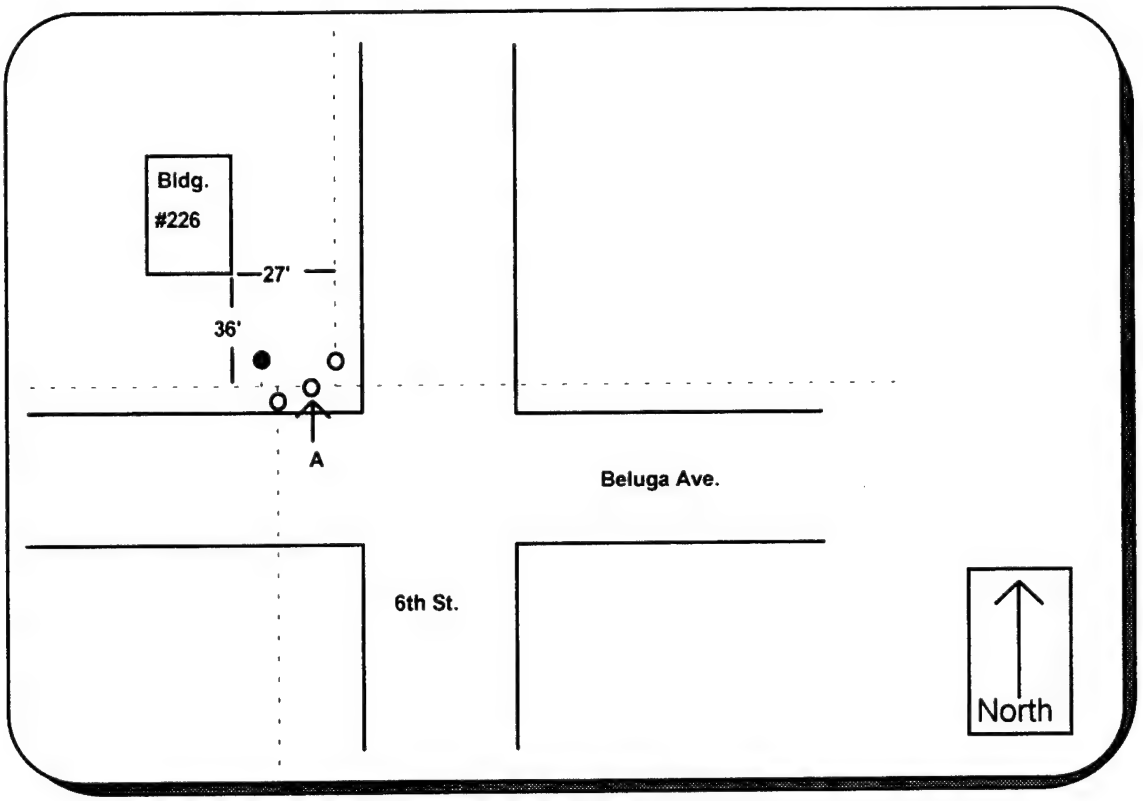
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Valve (middle valve)

Leak Location: 0' from A

Comments: This is a valve (middle) packing leak. Leak # G3-6

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

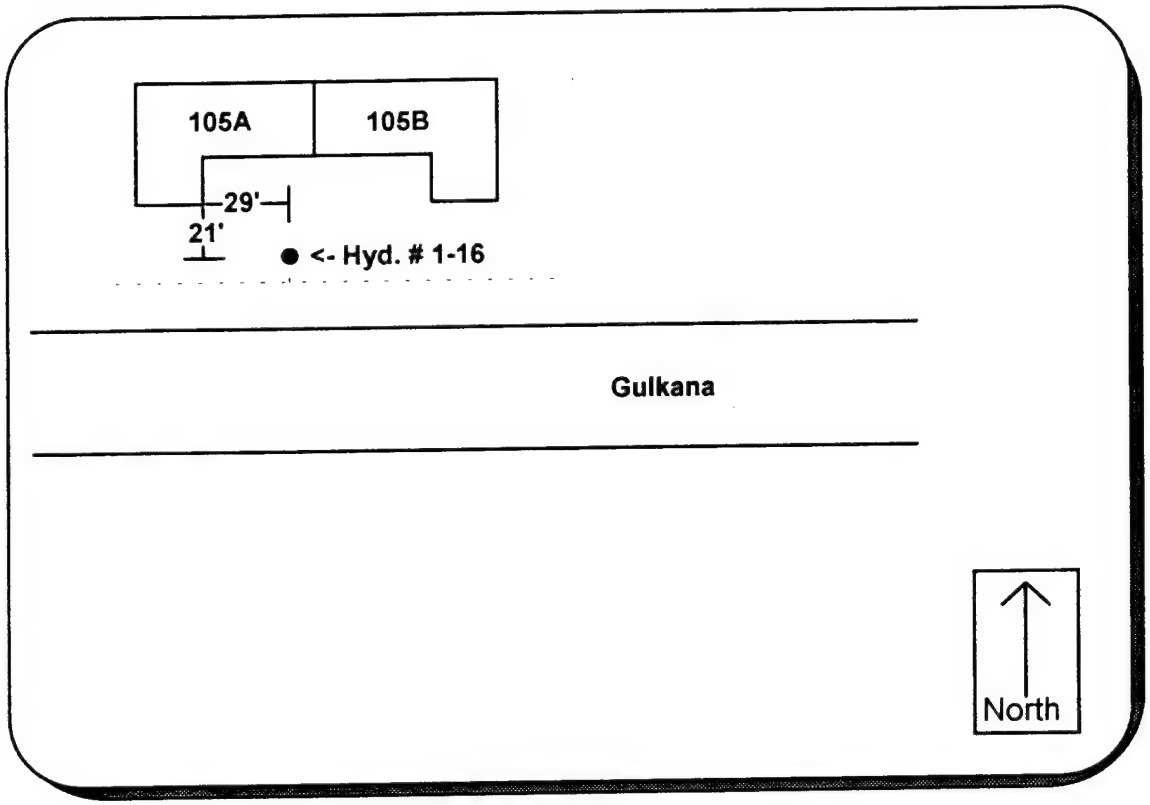
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Hydrant # 1-16

Leak Location: 0' from A

Comments: This is a hydrant (Hyd. # 1-16) leak. Leak # G3-7

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

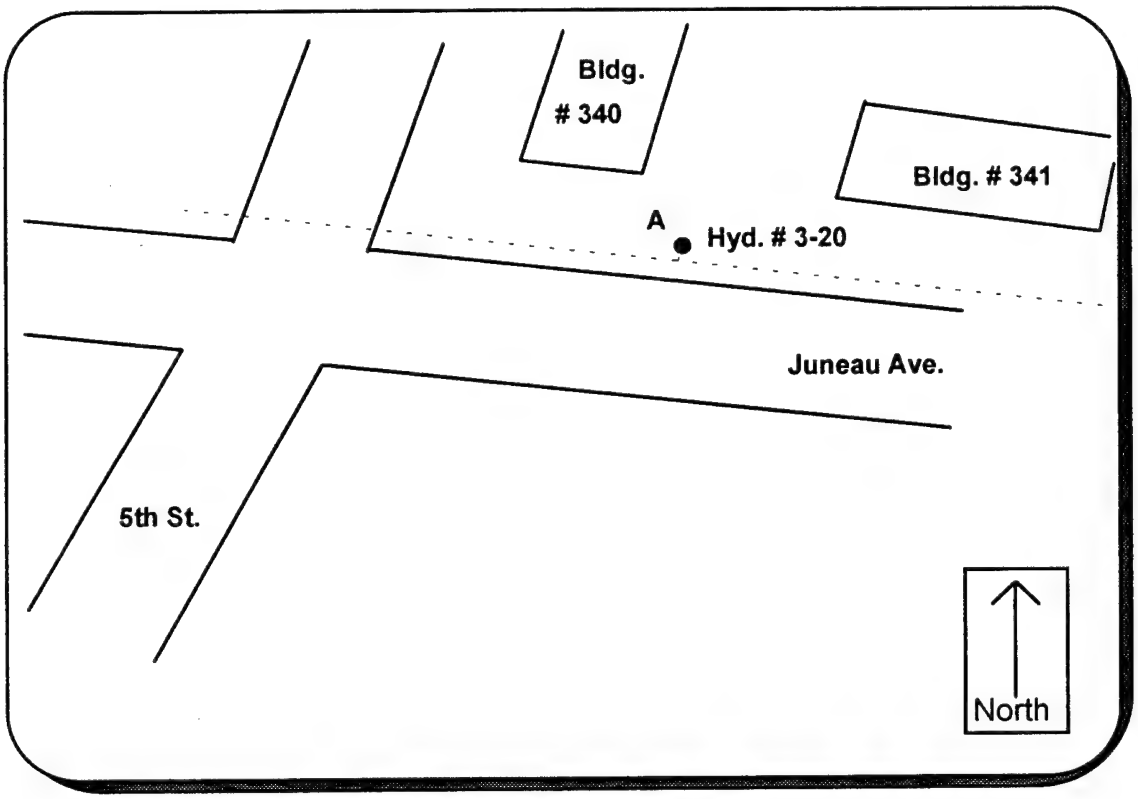
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 5, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A

Connection point: A= Hydrant # 3-20

Leak Location: 0' from A

Comments: This is a hydrant (Hyd. # 3-20) leak. Leak # G3-8

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

M.E. SIMPSON COMPANY, INC. - Professional Services

LEAK LOCATION REPORT

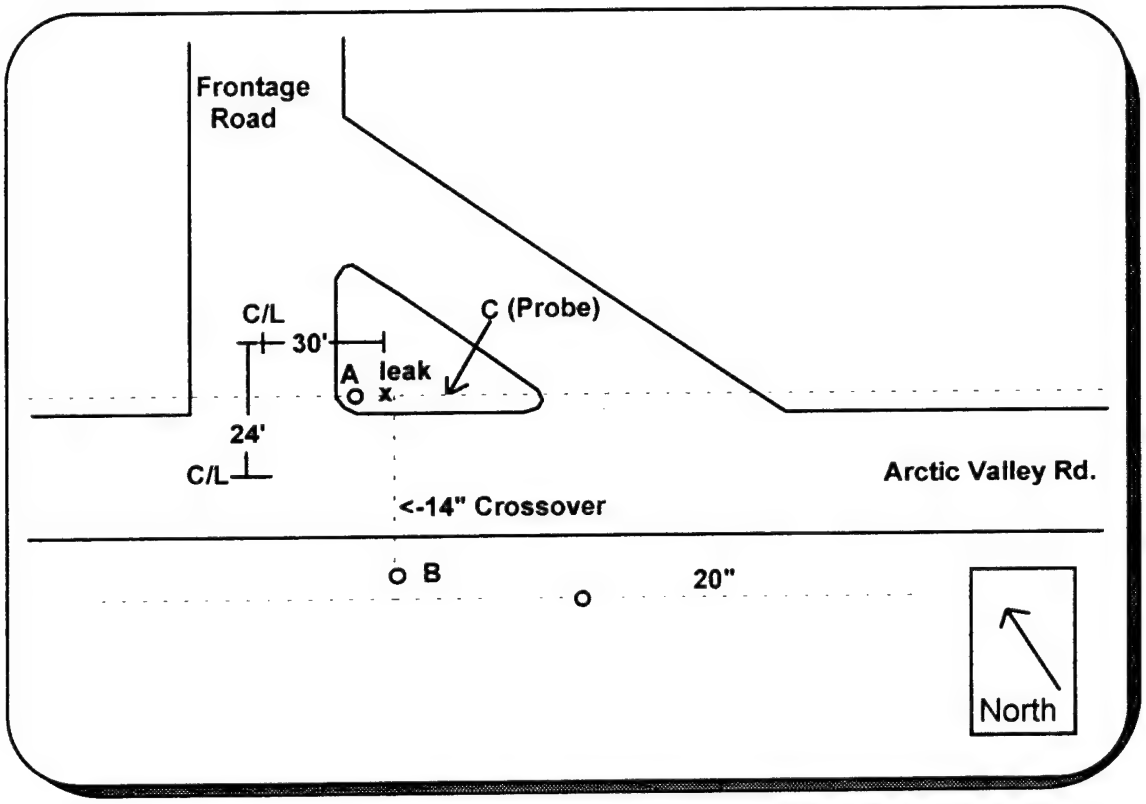
Client: Fort Richardson, AK

Time: Leak Survey

Date: June 6, 1995

Tech: Mike & John

Below is a diagram of the area surveyed for a suspect leak.



Distance: 112' from A to B / 32' from A to C

Connection point: A= 14" Main Line Valve Vault
Connection point: B= 14" Crossover Valve Vault
Connection point: C= Probe on pipe

Leak Location: 7' from A
Dig Location: 7' from A

Comments: Leak # G3-9

*We **thank you** for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.*

APPENDIX D

ENERGY AUDIT CALCULATIONS

Energy Cost Calculations
ECO #1 LCCA
ECO #2 LCCA
ECO #3 LCCA
ECO #4 LCCA
ECO #5 LCCA
LCCA Economic Factors

E M C ENGINEERS, INC.
2750 S. Wadsworth Blvd. Suite C-200 Denver, CO 80227 (303) 988-2951
9755 Dogwood Rd. Suite 220 Roswell, GA 30075 (404) 642-1864

JOB Ft. Richardson 1406-007
SHEET NO. 1 OF 3
CALCULATED BY TCP DATE 7-19-95
CHECKED BY _____ DATE _____
SCALE _____

Miscellaneous Electrical Consumption

Ft. Richardson utility data lists the only electrical consumption in the water distribution system as the backwash pumps at the Water Treatment Plant. However, there are other pumps that serve the distribution system:

1. Davis Hwy Pumphouse: (Pumps to cemetary, armory)
   - Pump No. 1 Baldor 7½ HP (Runs constantly ~~3~~ approx 6 mos/yr)
   - Pump No. 2 Baldor 7½ HP (Back up to #1)
   - Pump No. 3 U.S. Motor 40 HP (Seldom runs - Fire pump)

2. 2.5 Million gallon reservoir pump.
   - US Motor 30 HP
   - Pump operates approximately ~~3~~ 4 hours per day to overcome head from water treatment plant. (Runs 4 hrs/day non-continuously) @ 1000 gpm according to Ft. Rich. personnel.

3. Recirculation pump - @ N. Warehouse Road.
   - U.S. Motor 20 HP
   - Pump and heat exchanger pump water around the loop that serves the warehouses. Was installed because Ft. Richardson was concerned about freeze protection in this low-use area.
   - Runs constantly October to May. (7 months)

E M C ENGINEERS, INC.
2750 S. Wadsworth Blvd. Suite C-200 Denver, CO 80227 (303) 988-2951
9755 Dogwood Rd. Suite 220 Roswell, GA 30075 (404) 642-1864

JOB Ft. Richardson 1406-007
SHEET NO. 2 OF 3
CALCULATED BY TCP DATE 7-19-95
CHECKED BY _____ DATE _____
SCALE _____

Electrical Consumption - Circulation Pumps

In order to calculate electrical consumption, use following equation:

$$KWH = \frac{(HP)(0.746)(LF)(hours)}{\eta}$$

where: KWH = electricity consumed
HP = nameplate horsepower
0.746 = conversion factor HP to KWH
LF = load factor (assume 0.75)
hours = annual operating hours
η = motor efficiency

Pump	HP	Hours	η	KWH
Davis Hwy Pump #1	7.5	4,380	86%	21,372
Reservoir Pump	30	1,100	88%	20,981
Recirculation Pump	20	5,125	88%	65,170

Total = 107,523 KWH

At electrical rate = $0.0633 per KWH, total cost = $6,800

Total amount of water produced at Ft. Richardson = 1,477,077 Kgal

Cost of water (misc. electrical) = $0.0046/Kgal

E M C ENGINEERS, INC.
2750 S. Wadsworth Blvd. Suite C-200 Denver, CO 80227 (303) 988-2951
9755 Dogwood Rd. Suite 220 Roswell, GA 30075 (404) 642-1864

JOB Ft. Richardson 1406-007
SHEET NO. 3 OF 3
CALCULATED BY TCP DATE 7-19-95
CHECKED BY _____ DATE _____
SCALE _____

Cost of Water Production

- Data taken from Ft. Richardson dated 27 March 1995
- Total quantity of water used = 1,477,077 KGal/year (For period Oct-93 to Sep-94)
- Labor Cost for Production = $527,293 = $0.3570/KGAL
- Material Cost for Production = $70,497 = $0.0477/KGAL
- Maintenance Costs = $452,556 = $0.3064/KGAL
- Electrical Cost for Production = $586 = $0.0004/KGAL
- Electrical Cost for Circulation Pumps = $6,800 = $0.0046/KGAL
- Total Cost = $1,057,732 = $0.7161/KGAL
- Note: Costs for production and maintenance are variable costs. That is, costs vary with the amount of water produced. Therefore, cost savings can be claimed at this rate for water saved through ECO implementation.

Energy and non-energy costs must be separated for LCCA because different discount factors apply to each.

∴ Energy (Electrical) Costs = $0.0005/KGAL
Production Costs = $0.4047/KGAL
Maintenance Costs = $0.3064/KGAL
Non-Energy Costs = $0.7111/KGAL
Total Costs = $0.7161/KGAL

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Richardson, AK | REGION: 4 (Alaska) | PROJECT NO: 1406-007
PROJECT TITLE: Water Conservation Study | FISCAL YEAR: 1995
ANALYSIS DATE: 08/02/95 | ECONOMIC LIFE: 20 | PREPARED BY: TCP

1. INVESTMENT: **ECO #1 - Repair Main Line Leaks**

A. CONSTRUCTION COST	=	$6,982	
B. SIOH COST	(6.0% of 1A) =	$419	
C. DESIGN COST	(6.0% of 1A) =	$419	
D. TOTAL COST	(1A +1B +1C) =	$7,820	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	=	$0	
F. PUBLIC UTILITY COMPANY REBATE	=		
G. TOTAL INVESTMENT	(1D -1E -1F) =	------->	$7,820

2. ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: JAN '95

ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A. ELECTRICAL	$0.005	78,840	$394	15.08	$5,945	
B. DIST	$0.05	0	$0	18.57	$0	
C. RESID	$5.00	0	$0	21.02	$0	
D. NAT GAS	$4.00	0	$0	18.58	$0	
E. COAL	$2.60	0	$0	16.83	$0	
F.						
G. TOTAL		78,840	$394		-------->	$5,945

3. NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1 PRODUCTION ($0.4047/KGAL)	$31,907	14.88	$474,769	
2 MAINTENANCE ($0.3064/KGAL)	$24,157	14.88	$359,450	
3	$0	14.88	$0	
4 TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$56,063		$834,219	

B. NON-RECURRING (+/-)

ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/COST (4)	
a.				$0	
b.				$0	
c.				$0	
d. TOTAL	$0			$0	

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-) (3A4 + 3Bd4) = $834,219

4. FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2G3 + 3A + (3Bd1/Economic Life))	$56,457
5. SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =	0.14
6. TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =	$840,164
7. DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =	107.44

Ft Richardson Water - ECO #1
Water Conservation Study
Patch Main Line Leaks
Leak Detection Survey
June 1995

Designed By: MJS
Estimated By:

Prepared By: TCP

Preparation Date: 07/14/95
Effective Date of Pricing: 07/14/95

Sales Tax: 0.00%

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

	QUANTITY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST	UNIT COST
01 Water Supply & Distribution	1.00	LF	1,250	0	1,000	0	2,250	2250.00
03 Site Earthwork	1.00	CY	676	77	1,594	423	2,693	2693.36
TOTAL Ft Richardson Water - ECO #1	1.00	EA	1,926	77	2,594	423	4,943	4943.36
Contractor's Overhead							742	
SUBTOTAL							5,685	
Contractor's Profit							568	
SUBTOTAL							6,253	
Contractor's Bond							94	
TOTAL INCL INDIRECTS							6,347	
Contingency							635	
TOTAL INCL OWNER COSTS							6,982	

A-11

01.02. Potable Water Distribution			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
01. Water Supply & Distribution Systems									
01.02. Potable Water Distribution									
	USR AA <	> Patch Pipe Leak	5.00	EA	1,250	0	1,000	0	2,250
		TOTAL Potable Water Distribution			1,250	0	1,000	0	2,250
		TOTAL Water Supply & Distribution			1,250	0	1,000	0	2,250

03.02. Common Excavation & Disposal			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
03. Site Earthwork									
03.02. Common Excavation & Disposal									
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	200.00	CY	0	3	140	170	310
	TOTAL	Common Excavation & Disposal			0	3	140	170	310
03.04. Fill & Borrow									
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader	50.00	CY	676	55	290	105	1,071
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	150.00	CY	0	3	129	78	206
	TOTAL	Fill & Borrow			676	58	419	183	1,277
03.05. Compaction									
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers	200.00	CY	0	15	549	14	563
	TOTAL	Compaction			0	15	549	14	563
03.10. Temporary Dewatering									
	USR AA <	> Dewatering	7.00	DAY	0	0	487	56	543
	TOTAL	Temporary Dewatering			0	0	487	56	543
	TOTAL	Site Earthwork			676	77	1,594	423	2,693
	TOTAL	Ft Richardson Water - ECO #1			1,926	77	2,594	423	4,943

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION:	Ft. Richardson, AK	REGION: 4 (Alaska)		PROJECT NO:	1406-007
PROJECT TITLE:	Water Conservation Study			FISCAL YEAR:	1995
ANALYSIS DATE:	07/19/95	ECONOMIC LIFE:	20	PREPARED BY:	TCP

1 INVESTMENT: **ECO #2 - Repair Valve Leaks**

A. CONSTRUCTION COST	=		$13,596	
B. SIOH COST	(6.0% of 1A) =		$816	
C. DESIGN COST	(6.0% of 1A) =		$816	
D. TOTAL COST	(1A +1B +1C) =		$15,228	
E. SALVAGE VALUE OF EXISTING EQUIPMENT =			$0	
F. PUBLIC UTILITY COMPANY REBATE =				
G. TOTAL INVESTMENT	(1D -1E -1F) =		------->	$15,228

2 ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: JAN '95

ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A. ELECTRICAL	$0.005	4,562	$23	15.08	$344	
B. DIST	$0.05	0	$0	18.57	$0	
C. RESID	$5.00	0	$0	21.02	$0	
D. NAT GAS	$4.00	0	$0	18.58	$0	
E. COAL	$2.60	0	$0	16.83	$0	
F.						
G. TOTAL		4,562	$23		-------->	$344

3 NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1 PRODUCTION ($0.4047/KGAL)	$1,846	14.88	$27,472	
2 MAINTENANCE ($0.3064/KGAL)	$1,398	14.88	$20,799	
3	$0	14.88	$0	
4 TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$3,244		$48,271	

B. NON-RECURRING (+/-)

ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/COST (4)	
a.				$0	
b.				$0	
c.				$0	
d. TOTAL	$0			$0	

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-) (3A4 + 3Bd4) = $48,271

4 FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2G3+3A+(3Bd1/Economic Life))	$3,267
5 SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =	4.66
6 TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =	$48,615
7 DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =	3.19

Ft Richardson Water - ECO #2
Water Conservation Study
Replace Leaking Valves
Leak Detection Survey
June 1995

Designed By: MJS
Estimated By:

Prepared By:
TCP

Preparation Date: 07/14/95
Effective Date of Pricing: 07/14/95

Sales Tax: 0.00%

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No Backup Reports...

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U.S. Army Corps of Engineers
PROJECT FTRCH2: Ft Richardson Water - ECO #2 - Water Conservation Study
Ft. Richardson Water Study - ECO #2
** PROJECT DIRECT SUMMARY - Scope **

		QUANTITY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST	UNIT COST
01	Water Supply & Distribution	1.00	LF	4,021	103	3,972	634	8,627	8626.76
02	Site Demolition & Relocation	1.00	SY	0	5	175	32	207	207.38
03	Site Earthwork	1.00	CY	68	14	577	147	792	792.18
TOTAL	Ft Richardson Water - ECO #2	1.00	EA	4,089	122	4,724	813	9,626	9626.33
	Contractor's Overhead							1,444	
	SUBTOTAL							11,070	
	Contractor's Profit							1,107	
	SUBTOTAL							12,177	
	Contractor's Bond							183	
	TOTAL INCL INDIRECTS							12,360	
	Contingency							1,236	
	TOTAL INCL OWNER COSTS							13,596	

01.02. Potable Water Distribution			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
01. Water Supply & Distribution Systems									
01.02. Potable Water Distribution									
	M MIL AA <02555 3001 >	4"(10cm) Cast Iron Gate Valve Includes Box	1.00	EA	380	11	429	78	887
	M MIL AA <02555 3002 >	6"(15cm) Cast Iron Gate Valve Includes Box	1.00	EA	493	15	571	105	1,169
	M MIL AA <02555 3003 >	8"(21cm) Cast Iron Gate Valve Includes Box	1.00	EA	766	18	686	126	1,577
	M MIL AA <02555 3004 >	10"(25cm) Cast Iron Gate Valve Includes Box	2.00	EA	2,382	60	2,286	325	4,993
		TOTAL Potable Water Distribution			4,021	103	3,972	634	8,627
		TOTAL Water Supply & Distribution			4,021	103	3,972	634	8,627

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02.03. Underground Site Demolition			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
02. Site Demolition & Relocation This includes the demolition and/or relocation of structures, pavements, fencing, and underground utilities. Disposal of debris or demolished material, including loading and hauling, is also included.									
02.03. Underground Site Demolition									
	USR AA <	> Demo Iron Valve 6" to 12" D Sewer/Water Pipe, No Excavation	5.00	EA	0	5	175	32	207
		TOTAL Underground Site Demolition			0	5	175	32	207
		TOTAL Site Demolition & Relocation			0	5	175	32	207

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03.02. Common Excavation & Disposal			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
03. Site Earthwork									
03.02. Common Excavation & Disposal									
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	80.00	CY	0	1	56	68	124
		TOTAL Common Excavation & Disposal			0	1	56	68	124
03.04. Fill & Borrow									
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader	5.00	CY	68	6	29	11	107
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	75.00	CY	0	2	64	39	103
		TOTAL Fill & Borrow			68	7	93	49	210
03.05. Compaction									
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers	80.00	CY	0	6	220	6	225
		TOTAL Compaction			0	6	220	6	225
03.10. Temporary Dewatering									
	USR AA <	> Dewatering	3.00	DAY	0	0	209	24	233
		TOTAL Temporary Dewatering			0	0	209	24	233
		TOTAL Site Earthwork			68	14	577	147	792
		TOTAL Ft Richardson Water - ECO #1			4,089	122	4,724	813	9,626

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Richardson, AK | REGION: 4 (Alaska) | PROJECT NO: 1406-007
PROJECT TITLE: Water Conservation Study | FISCAL YEAR: 1995
ANALYSIS DATE: 07/19/95 | ECONOMIC LIFE: 20 | PREPARED BY: TCP

1. INVESTMENT: **ECO #3 - Repair Hydrant Leaks**

A. CONSTRUCTION COST	=	$15,096	
B. SIOH COST	(6.0% of 1A) =	$906	
C. DESIGN COST	(6.0% of 1A) =	$906	
D. TOTAL COST	(1A +1B +1C) =	$16,908	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	=	$0	
F. PUBLIC UTILITY COMPANY REBATE	=		
G. TOTAL INVESTMENT	(1D -1E -1F) =	------->	$16,908

2. ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: JAN '95

ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A. ELECTRICAL	$0.005	2,190	$11	15.08	$165	
B. DIST	$0.05	0	$0	18.57	$0	
C. RESID	$5.00	0	$0	21.02	$0	
D. NAT GAS	$4.00	0	$0	18.58	$0	
E. COAL	$2.60	0	$0	16.83	$0	
F.						
G. TOTAL		2,190	$11		-------->	$165

3. NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1 PRODUCTION ($0.4047/KGAL)	$886	14.88	$13,188	
2 MAINTENANCE ($0.3064/KGAL)	$671	14.88	$9,985	
3	$0	14.88	$0	
4 TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$1,557		$23,173	

B. NON-RECURRING (+/-)

ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/COST (4)	
a.				$0	
b.				$0	
c.				$0	
d. TOTAL	$0			$0	
C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-)			(3A4 + 3Bd4) =		$23,173

4. FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2G3+3A+(3Bd1/Economic Life))	$1,568
5. SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =	10.78
6. TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =	$23,338
7. DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =	1.38

Ft Richardson Water - ECO #3
Water Conservation Study
Replace Leaking Hydrants
Leak Detection Survey
June 1995

Designed By: MJS
Estimated By:

Prepared By: TCP

Preparation Date: 07/14/95
Effective Date of Pricing: 07/14/95

Sales Tax: 0.00%

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U.S. Army Corps of Engineers
PROJECT FTRCH3: Ft Richardson Water - ECO #3 - Water Conservation Study
Ft. Richardson Water Study - ECO #3
** PROJECT DIRECT SUMMARY - Scope **

		QUANTITY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST	UNIT COST
01	Water Supply & Distribution	1.00	LF	3,784	50	1,910	33	5,727	5726.95
02	Site Demolition & Relocation	1.00	SY	0	56	2,179	399	2,578	2578.26
03	Site Earthwork	1.00	CY	676	77	1,316	391	2,383	2383.16
TOTAL	Ft Richardson Water - ECO #3	1.00	EA	4,460	182	5,405	823	10,688	10688.36
	Contractor's Overhead							1,603	
	SUBTOTAL							12,292	
	Contractor's Profit							1,229	
	SUBTOTAL							13,521	
	Contractor's Bond							203	
	TOTAL INCL INDIRECTS							13,724	
	Contingency							1,372	
	TOTAL INCL OWNER COSTS							15,096	

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01.02. Potable Water Distribution			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
01. Water Supply & Distribution Systems									
01.02. Potable Water Distribution									
	M MIL AA <15109 2102 >	6" Standard Fire Hydrant One Piece w/5'(1.5M)Burial Secti	6.00	EA	3,679	48	1,838	20	5,538
	M MIL AA <02455 1002 >	6" Dia Mechanical Joint, DI Pipe (15cm) Diameter, No Fittings	10.00	LF	105	2	71	13	189
		TOTAL Potable Water Distribution			3,784	50	1,910	33	5,727
		TOTAL Water Supply & Distribution			3,784	50	1,910	33	5,727

02.03. Underground Site Demolition			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
02. Site Demolition & Relocation This includes the demolition and/or relocation of structures, pavements, fencing, and underground utilities. Disposal of debris or demolished material, including loading and hauling, is also included.									
02.03. Underground Site Demolition									
	CIV AA <02112 8007 >	Demo Fire Hydrants Remove Only	6.00	EA	0	53	2,057	377	2,433
	CIV AA <02112 8006 >	Demo Welded St Pipe 6" to 12" D Sewer/Water Pipe, No Excavation	10.00	LF	0	3	122	22	145
		TOTAL Underground Site Demolition			0	56	2,179	399	2,578
		TOTAL Site Demolition & Relocation			0	56	2,179	399	2,578

03.02. Common Excavation & Disposal			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
03. Site Earthwork									
03.02. Common Excavation & Disposal									
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	200.00	CY	0	3	140	170	310
	TOTAL	Common Excavation & Disposal			0	3	140	170	310
03.04. Fill & Borrow									
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader	50.00	CY	676	55	290	105	1,071
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	150.00	CY	0	3	129	78	206
	TOTAL	Fill & Borrow			676	58	419	183	1,277
03.05. Compaction									
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers	200.00	CY	0	15	549	14	563
	TOTAL	Compaction			0	15	549	14	563
03.10. Temporary Dewatering									
	USR AA <	> Dewatering	3.00	DAY	0	0	209	24	233
	TOTAL	Temporary Dewatering			0	0	209	24	233
	TOTAL	Site Earthwork			676	77	1,316	391	2,383
	TOTAL	Ft Richardson Water - ECO #3			4,460	182	5,405	823	10,688

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Richardson, AK | REGION: 4 (Alaska) | PROJECT NO: 1406-007
PROJECT TITLE: Water Conservation Study | FISCAL YEAR: 1995
ANALYSIS DATE: 08/02/95 | ECONOMIC LIFE: 20 | PREPARED BY: TCP

1. INVESTMENT: **ECO #4 - Repair Discovered Leaks**

A. CONSTRUCTION COST	=		$35,674	
B. SIOH COST	(6.0% of 1A) =		$2,140	
C. DESIGN COST	(6.0% of 1A) =		$2,140	
D. TOTAL COST	(1A +1B +1C) =		$39,955	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	=		$0	
F. PUBLIC UTILITY COMPANY REBATE	=			
G. TOTAL INVESTMENT	(1D -1E -1F) =		------->	$39,955

2. ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: JAN '95

ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A. ELECTRICAL	$0.005	85,593	$428	15.08	$6,454	
B. DIST	$0.05	0	$0	18.57	$0	
C. RESID	$5.00	0	$0	21.02	$0	
D. NAT GAS	$4.00	0	$0	18.58	$0	
E. COAL	$2.60	0	$0	16.83	$0	
F.						
G. TOTAL		85,593	$428		-------->	$6,454

3. NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1 PRODUCTION ($0.4047/KGAL)	$34,639	14.88	$515,433	
2 MAINTENANCE ($0.3064/KGAL)	$26,226	14.88	$390,236	
3	$0	14.88	$0	
4 TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$60,865		$905,669	

B. NON-RECURRING (+/-)

ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/COST (4)	
a.				$0	
b.				$0	
c.				$0	
d. TOTAL	$0			$0	

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-) (3A4 + 3Bd4) = $905,669

4. FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2G3+3A+(3Bd1/Economic Life))	$61,293
5. SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =	0.65
6. TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =	$912,122
7. DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =	22.83

Ft Richardson Water - ECO #4
Water Conservation Study
Repair Discovered Leaks
Leak Detection Survey
June 1995

Designed By: MJS
Estimated By:

Prepared By: TCP

Preparation Date: 07/14/95
Effective Date of Pricing: 07/14/95

Sales Tax: 0.00%

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No Backup Reports...

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		QUANTITY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST	UNIT COST
01	Water Supply & Distribution	1.00	LF	9,055	153	6,882	667	16,604	16603.71
02	Site Demolition & Relocation	1.00	SY	0	56	2,354	431	2,785	2785.31
03	Site Earthwork	1.00	CY	1,420	167	3,488	961	5,869	5868.69
TOTAL	Ft Richardson Water - ECO #4	1.00	EA	10,475	376	12,724	2,059	25,258	25257.71
	Contractor's Overhead							3,789	
	SUBTOTAL							29,046	
	Contractor's Profit							2,905	
	SUBTOTAL							31,951	
	Contractor's Bond							479	
	TOTAL INCL INDIRECTS							32,430	
	Contingency							3,243	
	TOTAL INCL OWNER COSTS							35,673	

01.02. Potable Water Distribution			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
01. Water Supply & Distribution Systems									
01.02. Potable Water Distribution									
	M MIL AA <15109 2102 >	6" Standard Fire Hydrant One Piece w/5'(1.5M)Burial Secti	6.00	EA	3,679	48	1,838	20	5,538
	M MIL AA <02455 1002 >	6" Dia Mechanical Joint, DI Pipe (15cm) Diameter, No Fittings	10.00	LF	105	2	71	13	189
	USR AA < >	Patch Pipe Leaks	5.00	EA	1,250	0	1,000	0	2,250
	M MIL AA <02555 3001 >	4"(10cm) Cast Iron Gate Valve Includes Box	1.00	EA	380	11	429	78	887
	M MIL AA <02555 3002 >	6"(15cm) Cast Iron Gate Valve Includes Box	1.00	EA	493	15	571	105	1,169
	M MIL AA <02555 3003 >	8"(21cm) Cast Iron Gate Valve Includes Box	1.00	EA	766	18	686	126	1,577
	M MIL AA <02555 3004 >	10"(25cm) Cast Iron Gate Valve Includes Box	2.00	EA	2,382	60	2,286	325	4,993
		TOTAL Potable Water Distribution			9,055	153	6,882	667	16,604
		TOTAL Water Supply & Distribution			9,055	153	6,882	667	16,604

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02.03. Underground Site Demolition			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
02. Site Demolition & Relocation This includes the demolition and/or relocation of structures, pavements, fencing, and underground utilities. Disposal of debris or demolished material, including loading and hauling, is also included.									
02.03. Underground Site Demolition									
	CIV AA <02112 8007 >	Demo Fire Hydrants Remove Only	6.00	EA	0	53	2,057	377	2,433
	CIV AA <02112 8006 >	Demo Welded St Pipe 6" to 12" D Sewer/Water Pipe, No Excavation	10.00	LF	0	3	122	22	145
		Fire Hydrant Replacement							
	USR AA < >	Demo Iron Valve 6" to 12" D Valve replacement	5.00	LF	0	0	175	32	207
		TOTAL Underground Site Demolition			0	56	2,354	431	2,785
		TOTAL Site Demolition & Relocation			0	56	2,354	431	2,785

03.02. Common Excavation & Disposal			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
03. Site Earthwork									
03.02. Common Excavation & Disposal									
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	200.00	CY	0	3	140	170	310
		Excavation for hydrant leaks							
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	200.00	CY	0	3	140	170	310
		Excavation for Main Leaks							
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	80.00	CY	0	1	56	68	124
		Valve Replacement							
	TOTAL	Common Excavation & Disposal			0	8	337	407	744
03.04. Fill & Borrow									
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader For hydrant replacement	50.00	CY	676	55	290	105	1,071
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	150.00	CY	0	3	129	78	206
		For hydrant replacement							
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader For main line leak repair	50.00	CY	676	55	290	105	1,071
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	150.00	CY	0	3	129	78	206
		For Main Line Leak repair							
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader Valve replacement	5.00	CY	68	6	29	11	107
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	75.00	CY	0	2	64	39	103
		Valve Replacement							
	TOTAL	Fill & Borrow			1,420	124	930	415	2,765
03.05. Compaction									
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers	200.00	CY	0	15	549	14	563
		For hydrant replacement							
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate 15cm) Layers	200.00	CY	0	15	549	14	563
		For main line leak repair							

03.05. Compaction			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers Valve replacement		80.00	CY	0	6	220	6	225
	TOTAL Compaction				0	36	1,317	34	1,351
03.10. Temporary Dewatering									
USR AA <	> Dewatering For hydrant replacement		3.00	DAY	0	0	209	24	233
USR AA <	> Dewatering For main line leak repair		7.00	DAY	0	0	487	56	543
USR AA <	> Dewatering Valve replacement		3.00	DAY	0	0	209	24	233
	TOTAL Temporary Dewatering				0	0	904	105	1,008
	TOTAL Site Earthwork				1,420	167	3,488	961	5,869
	TOTAL Ft Richardson Water - ECO #4				10,475	376	12,724	2,059	25,258

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LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION:	Ft. Richardson, AK	REGION: 4 (Alaska)		PROJECT NO:	1406-007
PROJECT TITLE:	Water Conservation Study			FISCAL YEAR:	1995
ANALYSIS DATE:	10/01/95	ECONOMIC LIFE:	20	PREPARED BY:	T. Poeling

1. INVESTMENT: **ECO #5 - Implement Leak Detection Program**

A.	CONSTRUCTION COST	=	$21,250	
B.	SIOH COST	(6.0% of 1A) =	$1,275	
C.	DESIGN COST	(6.0% of 1A) =	$1,275	
D.	TOTAL COST	(1A +1B +1C) =	$23,800	
E.	SALVAGE VALUE OF EXISTING EQUIPMENT	=	$0	
F.	PUBLIC UTILITY COMPANY REBATE	=		
G.	TOTAL INVESTMENT	(1D -1E -1F) =	------->	$23,800

2. ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: JAN '95

	ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A.	ELECTRICAL	$0.005	49,384	$247	15.08	$3,724	
B.	DIST	$0.05	0	$0	18.57	$0	
C.	RESID	$5.00	0	$0	21.02	$0	
D.	NAT GAS	$4.00	0	$0	18.58	$0	
E.	COAL	$2.60	0	$0	16.83	$0	
F.			0	$0		$0	
G.	TOTAL		49,384	$247		-------->	$3,724

3. NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1	PRODUCTION ($0.4047/KGAL)	$19,986	14.88	$297,385
2	MAINTENANCE ($0.3064/KGAL)	$15,131	14.88	$225,151
3		$0	14.88	$0
4	TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$35,117		$522,536

B. NON-RECURRING (+/-)

	ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/ COST (4)	
a.					$0	
b.					$0	
c.					$0	
d.	TOTAL	$0			$0	

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-) (3A4 + 3Bd4) = $522,536

4.	FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2H3 + 3A + (3Bd1/Economic Life))	$35,364
5.	SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =	0.67
6.	TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =	$526,259
7.	DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =	22.11

E M C Engineers, Inc.
Ft. Richardson, AK
EMC #1406-007

Prepared by: T Poeling
10/1/95
Checked by: _____

WATER AUDIT WORKSHEET

		Gallons/Year
Total Amount of Water Produced:		1,554,818,000
System Losses (5%):	-	77,741,000
Quantity Used:		1,477,077,000
Furnished to Elemendorf AFB (metered):	-	929,615,000
Total Amount of Water Produced (Ft. Richardson):		**547,462,000**

Water Uses (From 1994 data provided by Ft. Richardson):

Domestic Water Consumption:	=	414,558,800
Fire Hydrant Testing:	=	789,470
Electrical Plant:	=	11,564,000
Steam Plant:	=	14,745,000
Street Cleaning:	=	1,800,000
Discovered Leaks (by maintenance personnel, not leak detection survey):	=	15,120,000
Irrigation:	=	23,040,000
Total Identified Water Consumed:		**481,617,270**

Potential Water System Losses:			**65,844,730**
Recoverable Leakage (AWWA Manual 36 estimates 75% is recoverable):			**49,383,548**
Cost of Water Supply (per 1000 gallons):			**$0.716**
One Year Benefit from Recoverable Leakage:			**$35,364**
Total Cost of Leak Detection Program:	$250 / mile x 85 miles	=	**$23,800**
Benefit to Cost Ratio:			**1.49**
Simple Payback (years):			**0.67**

WATER AUDIT WORKSHEET

For: Ft. Richardson, AK Audit Study Period: Oct 1993 - Sep 1994

Line	Item	Water Volume Subtotal	Water Volume Total Cumulative	Water Volume Units*
Task 1—Measure Supply				
1	Uncorrected total water supply to the distribution system (total of master meters)	1,554,818		KGAL/YR
2A-C	Adjustments to total water supply			"
2A	Source meter error (+ or –)	-77,741		
2B	Change in reservoir and tank storage (+ or –)			
2C	Other contributions or losses (+ or –)			
3	Total adjustments to total water supply (add lines 2A, 2B, and 2C)			
4	Adjusted total water supply to the distribution system (add line 1 and line 3)		1,477,077	"
Task 2—Measure Metered Use				
5	Uncorrected total metered water use Elementdorf	929,615		"
6	Adjustments due to meter reading lag time (+ or –)			
7	Metered deliveries (add lines 5 and 6)			
8A-C	Total sales meter error and system-service meter errors (+ or –)			
8A	Residential meter error			
8B	Large meter error			
8C	Total (add line 8A and 8B)			
9	Corrected total metered water deliveries (add lines 7 and 8C)			
10	Corrected total unmetered water (subtract line 9 from line 4)		547,462	"
11A-M	Authorized unmetered water uses			
11A	Firefighting and firefighting training	789		"
11B	~~Main flushing~~ Domestic Use	44,559		"

NOTE: 1 ac-ft = 43,560 ft^3 = 325,851 gal.

*Units of measure must be consistent throughout the worksheet. The particular unit used (that is, acre-feet, millions of gallons, cubic feet, cubic metres, or other unit) is left to the user.

Form continues on next page.

Line	Item	Water Volume: Subtotal	Water Volume: Total Cumulative	Units*
11A-M	Authorized unmetered water uses (continued)			
11C	Storm drain flushing			
11D	Sewer cleaning			
11E	Street cleaning	1,800		KGAL/YR
11F	Schools			
11G	Landscaping in large public areas:			
	Parks			
	Golf courses	13,680		"
	Cemeteries	6,048		"
	Playgrounds	1,548		"
	Highway median strips			
	Other landscaping	1,764		"
11H	Decorative water facilities			
11I	Swimming pools			
11J	Construction sites			
11K	Water quality and other testing (pressure testing pipe, water quality, etc.)			
11L	Process water at ~~treatment~~ steam plants	26,309		"
11M	Other unmetered uses			
12	Total authorized unmetered water (add lines 11A through 11M) .	466,497		"
13	Total water losses (subtract line 12 from line 10)		80,965	"
14A-H	Identified water losses			
14A	Accounting procedure errors			
14B	Illegal connections			
14C	Malfunctioning distribution system controls			
14D	Reservoir seepage and leakage			
14E	Evaporation			

NOTE: 1 ac-ft = 43,560 ft^3 = 325,851 gal.

*Units of measure must be consistent throughout the worksheet. The particular unit used (that is, acre-feet, millions of gallons, cubic feet, cubic metres, or other unit) is left to the user.

Form continues on next page.

Line	Item	Water Volume: Subtotal	Water Volume: Total Cumulative	Water Volume: Units*
14A-H	Identified water losses (continued)			
14F	Reservoir overflow			
14G	Discovered leaks	15,120		KGAL/yr.
14H	Theft			
15	Total identified water losses (add lines 14A through 14H)		15,120	"
16	Potential water system leakage (subtract line 15 from line 13)		65,845	"
17	Recoverable leakage (multiply line 16 by 0.75)		49,384	"

Line	Item	Dollars per Unit of Volume
18A-B	Cost savings	
18A	Cost of water supply	$0.005/KGAL
18B	Variable operation and maintenance costs	$0.7111/KGAL
19	Total costs per unit of recoverable leakage (add line 18A and line 18B)	$0.7161/KGAL

Line	Item	Dollars per Year
20	One-year benefit from recoverable leakage (multiply line 17 by line 19)	$35,364
21	Total benefits from recovered leakage (multiply line 20 by 2)	$70,728
22	Total costs of leak detection project	$23,800
23	Benefit to cost ratio (divide line 21 by line 22)	2.97

Prepared by:

Name Tom Poeling

Title EMC Engineers, Inc. Date 7/20/95

NOTE: 1 ac-ft = 43,560 ft^3 = 325,851 gal.

*Units of measure must be consistent throughout the worksheet. The particular unit used (that is, acre-feet, millions of gallons, cubic feet, cubic metres, or other unit) is left to the user.

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JOB 1406-007 Ft. Richardson
SHEET NO. 1 OF
CALCULATED BY TCP DATE 7-13-95
CHECKED BY DATE
SCALE Water Audit

Population / Water Consumption - Ft. Richardson

Source: U.S. Army Alaska Installation Population Profile (12/94)

Military Personnel - On Post

Residing in Family Quarters:	1,321
Residing in Barracks:	578
Other Military Residing on Post:	35
Residing in Transient Quarters:	757
Total:	2,691

Military Family Personnel - On Post

Army Residing on Post:	2,995
Other Military Residing on Post:	79
Residing in Transient Quarters:	658
Total:	3,732

Civilians - On Post

Residing on Post:	1
Family Members:	2
Residing in Transient Quarters:	94
Total:	97

Retirees

Residing in Transient Quarters:	13

Total Residing On Post:	**6,533**

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JOB 1406-007 Ft. Richardson
SHEET NO. 2 OF 3
CALCULATED BY TCP DATE 7-13-95
CHECKED BY _____ DATE _____
SCALE _____

Population / Water Consumption (cont)

Military Off-Post Personnel

Married:	666
Family Members:	823
Total:	1,489

Civilians - Off-Post

Total Civilian Employees:	1,581
Residents On-Post	(97)
Total:	1,484

Army Retirees:

Army:	1,327
Other DOD:	3,595
Total:	4,922

Note: Retirees family members residing off-post were not included in consumption data. It is assumed that they would spend limited time on-post, and therefore would not consume significant amounts of water.

Camp Carroll (National Guard)

Active Duty:	22,124 man-days
Other DOD:	30,272 "
Total:	52,396 man-days

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JOB 1406.007 Ft. Richardson
SHEET NO. 3 OF
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SCALE

Population / Domestic Water Consumption (cont.)

- According to Army Technical Manual TM 5-813-1 "Water Supply Sources and General Considerations," the design allowances for water consumption is:
  - Residents = 150 gal/person/day
  - Non-Residents = 50 gal/person/day
- Number of residents and non-residents based on demographics
  - Number residing on post ≈ 6,533 persons
  - Number residing off post ≈ 2,973 persons
  - Number of National Guard = 52,396 man-days @ Camp Carroll

Consumption

Residents: (6,533 persons)(150 gpd/person) = 979,950 gpd
Non-Residents: (2,973 persons)(50 gpd/person) = 148,650 gpd
Subtotal: 1,128,600 gpd
= 411,939,000 gal/yr.

National Guard: (52,396 man-days)(50 gpd) = 2,619,800 gal/yr.

Total = 414,558,800 gal/yr.

CHAPTER 1

GENERAL

1-1. Purpose

This manual provides guidance for selecting water sources, in determining water requirements for Army and Air Force installations including special projects, and for developing suitable sources of supply from ground or surface sources.

1-2. Scope

This manual is applicable in selection of all water sources and in planning or performing construction of supply systems. Other manuals in this series are:

TM 5-813-3/AFM 88-10, Vol. 3-Water Treatment
TM 5-813-4/AFM 88-10, Vol. 4-Water Storage
TM 5-813-5/AFM 88-10, Vol. 5-Water Distribution
TM 5-813-6/AFM 88-10, Chap. 6-Water Supply for Fire Protection
TM 5-813-7/AFM 88-10, Vol. 7-Water Supply for Special Projects
TB MED-229-Sanitary Control and Surveillance of Water Supplies at Fixed and Field Installations
AFR 161-44-Management of the Drinking Water Surveillance Program

1-3. Definitions

a. General definitions. The following definitions, relating to all water supplies, are established.

(1) Water works. All construction (structures, pipe, equipment) required for the collection, transportation, pumping, treatment, storage and distribution of water.

(2) Supply works. Dams, impounding reservoirs, intake structures, pumping stations, wells and all other construction required for the development of a water supply source.

(3) Supplyline. The pipeline from the supply source to the treatment works or distribution system.

(4) Treatment works. All basins, filters, buildings and equipment for the conditioning of water to render it acceptable for a specific use.

(5) Distribution system. A system of pipes and appurtenances by which water is provided for domestic and industrial use and firefighting.

(6) Feeder mains. The principal pipelines of a distribution system.

(7) Distribution mains. The pipelines that constitute the distribution system.

(8) Service line. The pipeline extending from the distribution main to building served.

(9) Effective population. This includes resident military and civilian personnel and dependents plus an allowance for nonresident personnel, derived as follows: The design allowance for nonresidents is 50 gal/person/day whereas that for residents is 150 gal/person/day. Therefore, an "effective-population" value can be obtained by adding one-third of the population figure for nonresidents to the figure for residents.

$$\text{Effective Population} = \frac{\text{Nonresident Population}}{3} + \text{Resident Population}$$

(10) Capacity factor. The multiplier which is applied to the effective population figure to provide an allowance for reasonable population increase, variations in water demand, uncertainties as to actual water requirements, and for unusual peak demands whose magnitude cannot be accurately estimated in advance. The Capacity Factor varies inversely with the magnitude of the population in the water service area.

(11) Design population. The population figure obtained by multiplying the effective-population figure by the appropriate capacity factor.

Design Population = [Effective Population]
x [Capacity Factor]

(12) Required daily demand. The total daily water requirement. Its value is obtained by multiplying the design population by the appropriate per capita domestic water allowance and adding to this quantity any special industrial, aircraft-wash, irrigation, air-conditioning, or other demands. Other demands include the amount necessary to replenish in 48 hours the storage required for fire protection and normal

CHAPTER 2

WATER REQUIREMENTS

2-1. Domestic requirements

The per-capita allowances, given in table 2-1, will be used in determining domestic water requirements. These allowances do NOT include special purpose water uses, such as industrial, aircraft-wash, air-conditioning, irrigation or extra water demands at desert stations.

2-2. Fire-flow requirements

The system must be capable of supplying the fire flow specified plus any other demand that cannot be reduced during the fire period at the required residual pressure and for the required duration. The requirements of each system must be analyzed to determine whether the capacity of the system is fixed by the domestic requirements, by the fire demands, or by a combination of both. Where fire-flow demands are relatively high, or required for long duration, and population and/or industrial use is relatively low, the total required capacity will be determined by the prevailing fire demand. In some exceptional cases, this may warrant consideration of a special water system for fire purposes, separate, in part or in whole, from the domestic system. However, such separate systems will be appropriate only under exceptional circumstances and, in general, are to be avoided.

2-3. Irrigation

The allowances indicated in table 2-1 include water for limited watering or planted and grassed areas. However, these allowances do not include major lawn or other irrigation uses. Lawn irrigation provisions for facilities, such as family quarters and temporary structures, in all regions will be limited to hose bibbs on the outside of buildings and risers for hose connections. Where substantial irrigation is deemed necessary and water is available, underground sprinkler systems may be considered. In general, such systems should receive consideration only in arid or semiarid areas where rainfall is less than about 25 inches annually. For Army Projects, all proposed installations require specific authorization from HQDA (DAEN-ECE-G), WASH, DC 20314. For Air Force projects, refer to AFM 88-15 and AFM 88-10, Vol. 4. Each project proposed must include thorough justification, detailed plans of connection to water source, estimated cost and a statement as to the adequacy of the water supply to support the irrigation system. The use of underground sprinkler systems will be limited as follows: Air Force Projects--Areas adjacent to hospitals, chapels, clubs, headquarters and administration buildings, and Army Projects--Areas adjacent to hospitals, chapels, clubs, headquarters and administration buildings, athletic fields, parade grounds, EM barracks, BOQ's, and other areas involving improved vegetative plantings which require frequent irrigation to maintain satisfactory growth.

a. Backflow prevention. Backflow prevention devices, such as a vacuum breaker or an air gap, will be provided for all irrigation systems connected to potable water systems. Installation of backflow preventers will be in accordance with AFM 88-21, Operation and Maintenance of Cross Connection Control and Backflow Prevention Systems (for Air Force facilities) and the National Association of Plumbing-Heating-Cooling Contractors (NAPHCC) "National Standard Plumbing Code," (see app. A for references). Single or multiple check valves are not acceptable backflow prevention devices and will not be used. Direct cross connections between potable and nonpotable water systems will not be permitted under any circumstances.

b. Use of treated wastewater. Effluent from wastewater treatment plants can be used for irrigation when authorized. Only treated effluent having a detectable chlorine residual at the most remote discharge point will be used. Where state or local regulations require additional treatment for irrigation, such requirement will be complied with. The effluent irrigation system must be physically separated from any distribution systems carrying potable water. A detailed plan will be provided showing the location of the effluent irrigation system in relation to the potable water distribution system and buildings. Provision will be made either for locking the sprinkler irrigation control valves or removing the valve handles so that only authorized personnel can operate the system. In

addition, readily identifiable "nonpotable" or "contaminated" notices, markings or codings for wastewater conveyance facilities and appurtenances will be provided. Another possibility for reuse of treated effluent is for industrial operations where substantial volumes of water for washing or cooling purposes are required. For any re use situation, great care must be exercised to avoid direct cross connections between the reclaimed water system and the potable water system.

c. Review of effluent irrigation projects. Concept plans for proposed irrigation projects using wastewater treatment plant effluent will be reviewed by the engineer and surgeon at Installation Command level and the Air Force Major Command, as appropriate. EM 1110-1-501 will serve as the basic criteria for such projects, as amended by requirements herein. This publication is available through HQ USACE publications channels (see app. A, References). Such projects will only be authorized after approval by HQDA (DAEN-ECE-G), WASH DC 20314 and HQDA (DASG-PSP-E), WASH DC 20310 for Army projects and by HQUSAF (HQ USAF/LEEEU), WASH DC 20332 and The Surgeon General, (HQ AFMSC/SGPA), Brooks AFB, TX 78235 for Air Force projects.

Table 2-1. Domestic Water Allowances for Army and Air Force Projects.[1]

	Gallons/Capita/Day[2]	
	Permanent Construction	Field Training Camps
USAF Bases and Air Force Stations	150[3]	--
Armored/Mech. Divisions	150	75
Camps and Forts	150[4]	50
POW and Internment Camps	--	50[4]
Hospital Units[5]	600/Bed	400/Bed
Hotel[6]	70	--
Depot, Industrial, Plant and Similar Projects	50 gal/employee/8-hr shift; 150 gal/capita/day for resident personnel	

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Notes:

[1] For Aircraft Control and Warning Stations, National Guard Stations, Guided Missile Stations, and similar projects, use TM 5-813-7/AFM 88-10, Volume 7 for water supply for special projects.

[2] The allowances given in this table include water used for laundries to serve resident personnel, washing vehicles, limited watering of planted and grassed areas, and similar uses. The allowances tabulated do NOT include special industrial or irrigation uses. The per capita allowance for nonresidents will be one-third that allowed for residents.

[3] An allowance of 150 gal/capita/day will also be used for USAF semi-permanent construction.

[4] For populations under 300, 50 gal capita/day will be used for base camps and 25 gal/capita/day for branch camps.

[5] Includes hotels and similar facilities converted to hospital use.

[6] Includes similar facilities converted for troop housing.

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Prepared by: T Poeling
7/13/95
Checked by: _____

FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
1	00-01	838	4,190	430	2,150
2	00-02	1,857	9,285	430	2,150
3	00-03	719	3,595	0	0
4	00-04	662	3,310	662	3,310
5	00-05	793	3,965	0	0
6	00-06	838	4,190	793	3,965
7	00-07	1,017	5,085	860	4,300
8	00-08	999	4,995	0	0
9	00-09	961	4,805	0	0
10	01-01	837	4,185	0	0
11	01-02	961	4,805	0	0
12	01-03	961	4,805	0	0
13	01-04	961	4,805	0	0
14	01-05	942	4,710	0	0
15	01-06	0	0	838	4,190
16	01-07	961	4,805	0	0
17	01-08	999	4,995	0	0
18	01-09	1,017	5,085	0	0
19	01-10	1,017	5,085	666	3,330
20	01-11	961	4,805	666	3,330
21	01-12	0	0	0	0
22	01-13	922	4,610	0	0
23	01-14	961	4,805	838	4,190
24	01-15	980	4,900	0	0
25	01-16	980	4,900	0	0
26	01-17	0	0	860	4,300
27	01-18	1,017	5,085	0	0
28	01-19	0	0	507	2,535
29	01-20	0	0	0	0
30	01-21	980	4,900	815	4,075
31	01-22	980	4,900	0	0
32	01-23	980	4,900	0	0
33	01-24	980	4,900	0	0
34	01-25	942	4,710	0	0
35	01-26	961	4,805	0	0
36	01-27	961	4,805	0	0
37	01-28	942	4,710	0	0
38	01-29	961	4,805	0	0
39	01-30	942	4,710	0	0
40	01-31	942	4,710	0	0
41	02-01	881	4,405	0	0
42	02-02	881	4,405	0	0
43	02-03	902	4,510	0	0
44	02-04	902	4,510	0	0
45	02-05	922	4,610	0	0
46	02-06	1,017	5,085	0	0
47	02-07	942	4,710	0	0

E M C Engineers, Inc.
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FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
48	02-08	942	4,710	0	0
49	02-09	902	4,510	0	0
50	02-10	881	4,405	0	0
51	02-11	902	4,510	0	0
52	02-12	881	4,405	0	0
53	02-13	942	4,710	0	0
54	02-14	902	4,510	0	0
55	02-15	881	4,405	0	0
56	02-16	922	4,610	0	0
57	02-17	922	4,610	0	0
58	02-18	961	4,805	0	0
59	02-19	902	4,510	0	0
60	02-20	881	4,405	0	0
61	02-21	902	4,510	0	0
62	02-22	902	4,510	0	0
63	02-23	860	4,300	0	0
64	03-01	881	4,405	0	0
65	03-02	881	4,405	0	0
66	03-03	860	4,300	0	0
67	03-04	902	4,510	0	0
68	03-05	860	4,300	0	0
69	03-06	922	4,610	0	0
70	03-07	942	4,710	0	0
71	03-08	922	4,610	0	0
72	03-09	902	4,510	0	0
73	03-10	961	4,805	0	0
74	03-11	961	4,805	0	0
75	03-12	942	4,710	0	0
76	03-13	922	4,610	0	0
77	03-14	902	4,510	0	0
78	03-15	520	2,600	0	0
79	03-16	902	4,510	0	0
80	03-17	922	4,610	0	0
81	03-18	922	4,610	0	0
82	03-19	902	4,510	0	0
83	03-20	922	4,610	0	0
84	03-21	902	4,510	0	0
85	03-22	0	0	0	0
86	03-23	0	0	0	0
87	03-24	902	4,510	0	0
88	03-25	902	4,510	0	0
89	03-26	922	4,610	0	0
90	03-27	0	0	0	0
91	03-28	902	4,510	0	0
92	03-29	0	0	0	0
93	04-01	783	3,915	0	0
94	04-02	801	4,005	0	0

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FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
95	04-03	801	4,005	0	0
96	04-04	745	3,725	0	0
97	04-05	942	4,710	0	0
98	04-06	942	4,710	0	0
99	04-07	0	0	0	0
100	04-08	902	4,510	0	0
101	04-09	922	4,610	0	0
102	04-10	922	4,610	793	3,965
103	04-11	902	4,510	0	0
104	04-12	902	4,510	0	0
105	04-13	902	4,510	0	0
106	04-14	949	4,745	0	0
107	04-15	764	3,820	0	0
108	05-01	902	4,510	0	0
109	05-02	1,061	5,305	0	0
110	05-03	860	4,300	0	0
111	05-04	745	3,725	0	0
112	05-05	704	3,520	0	0
113	05-06	0	0	0	0
114	05-07	764	3,820	639	3,195
115	05-08	860	4,300	0	0
116	05-09	838	4,190	666	3,330
117	05-10	764	3,820	0	0
118	05-11	815	4,075	0	0
119	05-12	838	4,190	0	0
120	05-13	838	4,190	0	0
121	05-14	881	4,405	0	0
122	05-15	745	3,725	0	0
123	05-16	783	3,915	0	0
124	06-01	881	4,405	0	0
125	06-02	922	4,610	0	0
126	06-03	922	4,610	0	0
127	06-04	881	4,405	0	0
128	06-05	902	4,510	0	0
129	06-06	902	4,510	0	0
130	06-07	902	4,510	0	0
131	06-08	922	4,610	0	0
132	06-09	860	4,300	0	0
133	06-10	860	4,300	0	0
134	06-11	881	4,405	0	0
135	06-12	881	4,405	0	0
136	06-13	783	3,915	0	0
137	06-14	881	4,405	0	0
138	06-15	881	4,405	0	0
139	06-16	881	4,405	0	0
140	06-17	860	4,300	0	0
141	06-18	881	4,405	0	0

E M C Engineers, Inc.
Ft. Richardson, AK
EMC #1406-007

Prepared by: T Poeling
7/13/95
Checked by: _____

FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
142	06-19	0	0	0	0
143	06-20	0	0	838	4,190
144	06-21	881	4,405	0	0
145	06-22	783	3,915	0	0
146	06-23	881	4,405	0	0
147	06-24	860	4,300	0	0
148	06-25	860	4,300	0	0
149	06-26	902	4,510	860	4,300
150	06-27	902	4,510	0	0
151	06-28	902	4,510	0	0
152	06-29	922	4,610	0	0
153	06-30	838	4,190	0	0
154	06-31	881	4,405	0	0
155	06-32	881	4,405	0	0
156	06-33	922	4,610	860	4,300
157	06-34	922	4,610	0	0
158	06-35	860	4,300	0	0
159	06-36	764	3,820	0	0
160	06-37	764	3,820	0	0
161	06-38	783	3,915	764	3,820
162	06-39	764	3,820	0	0
163	06-40	764	3,820	683	3,415
164	06-41	0	0	0	0
165	07-01	922	4,610	0	0
166	07-02	725	3,625	0	0
167	07-03	704	3,520	0	0
168	07-04	745	3,725	0	0
169	07-05	764	3,820	0	0
170	07-06	693	3,465	744	3,720
171	07-07	662	3,310	683	3,415
172	07-08	683	3,415	0	0
173	07-09	683	3,415	0	0
174	07-10	745	3,725	662	3,310
175	07-11	725	3,625	0	0
176	07-12	745	3,725	0	0
177	07-13	815	4,075	0	0
178	07-14	860	4,300	0	0
179	07-15	783	3,915	704	3,520
180	07-16	725	3,625	0	0
181	07-17	725	3,625	0	0
182	07-18	719	3,595	0	0
183	07-19	902	4,510	769	3,845
184	07-20	1,087	5,435	881	4,405
185	07-21	0	0	0	0
186	07-22	819	4,095	0	0
187	07-23	783	3,915	745	3,725
188	07-24	783	3,915	0	0

FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
189	07-25	837	4,185	0	0
190	07-26	854	4,270	0	0
191	07-27	854	4,270	0	0
192	07-28	854	4,270	0	0
193	07-29	961	4,805	0	0
194	07-30	860	4,300	0	0
195	07-31	764	3,820	0	0
196	07-32	860	4,300	0	0
197	07-33	745	3,725	704	3,520
198	07-34	838	4,190	0	0
199	07-35	922	4,610	838	4,190
200	07-36	961	4,805	0	0
201	08-01	860	4,300	719	3,595
202	08-02	860	4,300	744	3,720
203	08-03	860	4,300	744	3,720
204	08-04	860	4,300	769	3,845
205	08-05	804	4,020	769	3,845
206	08-06	769	3,845	769	3,845
207	08-07	719	3,595	744	3,720
208	08-08	693	3,465	719	3,595
209	08-09	856	4,280	815	4,075
210	08-10	888	4,440	815	4,075
211	08-11	769	3,845	666	3,330
212	08-12	744	3,720	680	3,400
213	08-13	793	3,965	693	3,465
214	08-14	793	3,965	666	3,330
215	08-15	793	3,965	719	3,595
216	08-16	860	4,300	719	3,595
217	08-17	815	4,075	719	3,595
218	08-18	793	3,965	719	3,595
219	08-19	744	3,720	719	3,595
220	08-20	744	3,720	744	3,720
221	08-21	815	4,075	719	3,595
222	08-22	860	4,300	719	3,595
223	08-23	902	4,510	719	3,595
224	08-24	902	4,510	693	3,465
225	08-25	902	4,510	666	3,330
226	08-26	881	4,405	637	3,185
227	08-27	804	4,020	430	2,150
228	08-28	815	4,075	430	2,150
229	08-29	804	4,020	430	2,150
230	08-30	769	3,845	430	2,150
231	08-31	815	4,075	430	2,150
232	08-32	719	3,595	769	3,845
233	08-33	769	3,845	693	3,465
234	08-34	815	4,075	693	3,465
235	08-35	793	3,965	637	3,185

E M C Engineers, Inc.
Ft. Richardson, AK
EMC #1406-007

Prepared by: T Poeling
7/13/95
Checked by: _____

FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
236	08-36	815	4,075	637	3,185
237	08-37	793	3,965	666	3,330
238	08-38	0	0	637	3,185
239	08-39	769	3,845	769	3,845
240	08-40	769	3,845	744	3,720
241	08-41	744	3,720	769	3,845
242	08-42	769	3,845	0	0
243	08-43	815	4,075	815	4,075
244	08-44	815	4,075	769	3,845
245	08-45	815	4,075	719	3,595
246	08-46	0	0	719	3,595
247	08-47	815	4,075	719	3,595
248	08-48	0	0	637	3,185
249	08-49	769	3,845	637	3,185
250	08-50	744	3,720	637	3,185
251	08-51	744	3,720	637	3,185
252	08-52	719	3,595	666	3,330
253	08-53	719	3,595	666	3,330
254	08-54	744	3,720	666	3,330
255	08-55	793	3,965	637	3,185
256	08-56	793	3,965	666	3,330
257	08-57	693	3,465	0	0
258	08-58	666	3,330	637	3,185
259	08-59	693	3,465	637	3,185
260	08-60	666	3,330	637	3,185
261	08-61	0	0	637	3,185
262	08-62	769	3,845	666	3,330
263	08-63	793	3,965	637	3,185
264	08-64	793	3,965	719	3,595
265	08-65	769	3,845	719	3,595
266	08-66	769	3,845	637	3,185
267	08-67	769	3,845	608	3,040
268	08-68	793	3,965	693	3,465
269	08-69	769	3,845	693	3,465
270	08-70	0	0	719	3,595
271	08-71	793	3,965	719	3,595
272	08-72	793	3,965	719	3,595
273	08-73	815	4,075	719	3,595
274	09-01	787	3,935	719	3,595
275	09-02	787	3,935	637	3,185
276	09-03	0	0	744	3,720
277	09-04	787	3,935	693	3,465
278	09-05	805	4,025	719	3,595
279	09-06	666	3,330	693	3,465
280	09-07	764	3,820	567	2,835
281	09-08	764	3,820	639	3,195
282	09-09	745	3,725	662	3,310

E M C Engineers, Inc.
Ft. Richardson, AK
EMC #1406-007

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7/13/95
Checked by: _____

FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
283	09-10	860	4,300	693	3,465
284	09-11	838	4,190	719	3,595
285	09-12	764	3,820	592	2,960
286	09-13	783	3,915	683	3,415
287	09-14	801	4,005	683	3,415
288	09-15	837	4,185	683	3,415
289	09-16	764	3,820	704	3,520
290	09-17	744	3,720	744	3,720
291	09-18	881	4,405	744	3,720
292	09-19	838	4,190	769	3,845
293	09-20	838	4,190	769	3,845
294	09-21	683	3,415	662	3,310
295	09-22	704	3,520	683	3,415
296	09-23	683	3,415	662	3,310
297	09-24	725	3,625	704	3,520
298	09-25	764	3,820	725	3,625
299	09-27	0	0	769	3,845
300	09-28	815	4,075	769	3,845
301	09-29	0	0	769	3,845
302	09-30	0	0	769	3,845
303	11-01	902	4,510	838	4,190
304	11-02	860	4,300	838	4,190
305	11-03	860	4,300	838	4,190
306	11-04	902	4,510	838	4,190
307	11-05	902	4,510	838	4,190
308	11-06	881	4,405	838	4,190
309	28-01	616	3,080	639	3,195
310	35-01	719	3,595	744	3,720
311	45-01	471	2,355	384	1,920
312	45-02	577	2,885	384	1,920
313	45-03	471	2,355	577	2,885
314	45-04	471	2,355	577	2,885
315	45-05	719	3,595	719	3,595
316	45-06	616	3,080	639	3,195
317	45-07	639	3,195	639	3,195
318	45-08	719	3,595	719	3,595
319	45-09	662	3,310	639	3,195
320	45-10	662	3,310	662	3,310
321	45-11	662	3,310	662	3,310
322	45-12	744	3,720	744	3,720
323	45-13	662	3,310	662	3,310
324	45-14	719	3,595	769	3,845
325	45-15	719	3,595	769	3,845
326	45-16	693	3,465	769	3,845
327	45-17	719	3,595	666	3,330
328	45-18	719	3,595	719	3,595
329	45-19	744	3,720	719	3,595

E M C Engineers, Inc.
Ft. Richardson, AK
EMC #1406-007

Prepared by: T Poeling
7/13/95
Checked by: _____

FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
330	45-20	719	3,595	719	3,595
331	45-21	693	3,465	719	3,595
332	45-22	693	3,465	719	3,595
333	45-23	719	3,595	719	3,595
334	45-24	0	0	719	3,595
335	45-25	0	0	719	3,595
336	45-26	0	0	744	3,720
337	45-27	0	0	838	4,190
338	45-28	0	0	769	3,845
339	45-29	0	0	769	3,845
340	45-30	704	3,520	662	3,310
341	45-31	961	4,805	838	4,190
342	45-32	961	4,805	961	4,805
343	45-33	540	2,700	801	4,005
344	45-34	662	3,310	783	3,915
345	45-35	662	3,310	764	3,820
346	45-36	0	0	881	4,405
347	45-37	662	3,310	764	3,820
348	45-38	704	3,520	745	3,725
349	45-39	744	3,720	860	4,300
350	45-40	639	3,195	639	3,195
351	45-41	662	3,310	662	3,310
352	45-42	639	3,195	662	3,310
353	45-43	662	3,310	639	3,195
354	45-44	693	3,465	719	3,595
355	45-45	639	3,195	639	3,195
356	45-46	662	3,310	616	3,080
357	45-47	1,244	6,220	961	4,805
358	47-01	483	2,415	513	2,565
359	47-02	471	2,355	577	2,885
360	47-03	509	2,545	577	2,885
361	47-04	0	0	577	2,885
362	47-05	471	2,355	544	2,720
363	47-06	666	3,330	577	2,885
364	47-07	693	3,465	577	2,885
365	47-08	666	3,330	577	2,885
366	47-09	693	3,465	577	2,885
367	47-10	666	3,330	577	2,885
368	47-11	719	3,595	608	3,040
369	47-12	666	3,330	608	3,040
370	47-13	666	3,330	637	3,185
371	47-14	693	3,465	637	3,185
372	47-15	666	3,330	608	3,040
373	47-16	719	3,595	637	3,185
374	47-17	0	0	637	3,185
375	47-18	693	3,465	637	3,185
376	47-19	719	3,595	637	3,185

E M C Engineers, Inc.
Ft. Richardson, AK
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7/13/95
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FIRE HYDRANT TESTING RESULTS

NO.	HYDRANT NO.	1993 TEST FLOW (GPM)	TOTAL WATER USAGE (1993)	1994 TEST FLOW (GPM)	TOTAL WATER USAGE (1994)
377	47-20	639	3,195	567	2,835
378	47-21	639	3,195	567	2,835
379	47-22	616	3,080	639	3,195
380	47-23	0	0	719	3,595
381	47-24	0	0	666	3,330
382	57-01	854	4,270	419	2,095
383	57-02	231	1,155	419	2,095
384	57-03	260	1,300	471	2,355
385	57-04	260	1,300	471	2,355
386	57-05	206	1,030	509	2,545
387	57-06	0	0	452	2,260
388	57-07	260	1,300	544	2,720
389	57-08	253	1,265	483	2,415
390	57-09	0	0	483	2,415
391	57-10	285	1,425	544	2,720
392	57-11	0	0	513	2,565
393	57-12	318	1,590	577	2,885
394	57-13	318	1,590	577	2,885
395	57-14	260	1,300	608	3,040
396	57-15	318	1,590	608	3,040
397	57-16	318	1,590	608	3,040
398	57-17	329	1,645	577	2,885
399	57-18	318	1,590	544	2,720
400	57-19	349	1,745	577	2,885
401	57-20	329	1,645	577	2,885
402	57-21	349	1,745	577	2,885
403	57-22	349	1,745	544	2,720
404	57-23	253	1,265	483	2,415
405	57-24	253	1,265	253	1,265
406	58-01	693	3,465	107	535
407	58-02	719	3,595	107	535
408	58-03	513	2,565	382	1,910
409	59-01	509	2,545	120	600
410	59-02	544	2,720	120	600
411	59-03	0	0	0	0
412	59-04	509	2,545	0	0
413	59-05	544	2,720	0	0
414	N-01	719	3,595	384	1,920
415	N-02	719	3,595	0	0
416	N-03	719	3,595	0	0
417	N-04	744	3,720	0	0
418	N-05	719	3,595	0	0
419	N-06	719	3,595	0	0
420	N-07	719	3,595	0	0
421	N-08	719	3,595	0	0
Total			1,496,340		789,470

E M C ENGINEERS, INC.
2750 S. Wadsworth Blvd. Suite C-200 Denver, CO 80227 (303) 988-2951
9755 Dogwood Rd. Suite 220 Roswell, GA 30075 (404) 642-1864

JOB 1406-007 Ft. Richardson
SHEET NO ____ OF ____
CALCULATED BY TCP DATE 7-14-95
CHECKED BY ____ DATE ____
SCALE ____

Irrigation - Water Consumption

- Water is used to irrigate the golf course, cemetary, athletic fields, and other miscellaneous fields.
- Assume irrigation occurs between May 15 and September 15. ⇒ Approximately 120 days.
- Assume water is used for the equivalent of 4 hours (240 min.) per day.
- Assume water usage is based on capacity of water lines feeding these areas:

Capacity

Location	Water Line	Capacity (gpm)
Golf Course	4"	210
"	4"	210
"	2½"	55
Cemetary	4"	210
Athletic Fields	2½"	55
Misc. Irrigation	2½"	55
	Total:	795 ⇒ 800 gpm

Total Consumption: (800 gpm)(240 min/day)(120 day/year)

Total: 23,040,000 gal/year

DISCOVERED WATER LEAKS - REPAIRED BREAKS (1994)

BREAK NO.	LOCATION	PIPE SIZE (IN)	ESTIMATED LEAKAGE (GPM)	ESTIMATED DAYS TO REPAIR	TOTAL WATER LOST (GAL)
1	Bell Joint Leak by Boundry	20	100	30	4,320,000
2	Break Near Bldg. 932	6	50	30	2,160,000
3	Break Near Totman Road	8	50	30	2,160,000
4	Break Near Davis Hwy, Armory	6	50	30	2,160,000
5	Break West of Bldg. 618	12	50	30	2,160,000
6	Break Near Bldg. 45590	8	50	30	2,160,000
	Total				15,120,000

NISTIR 85-3273-9
(Rev. 10/94)

Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis 1995

Annual Supplement to
NIST Handbook 135 and
NBS Special Publication 709

Stephen R. Petersen

U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Institute of Standards
and Technology

Prepared for
United States Department of Energy
Federal Energy Management Program

October 1994

Table Ba-4. UPV* Discount Factors adjusted for fuel price escalation, by end-use sector and fuel type.[a]
Discount Rate = 3.0 percent (FEMP)

Census Region 4 (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming)

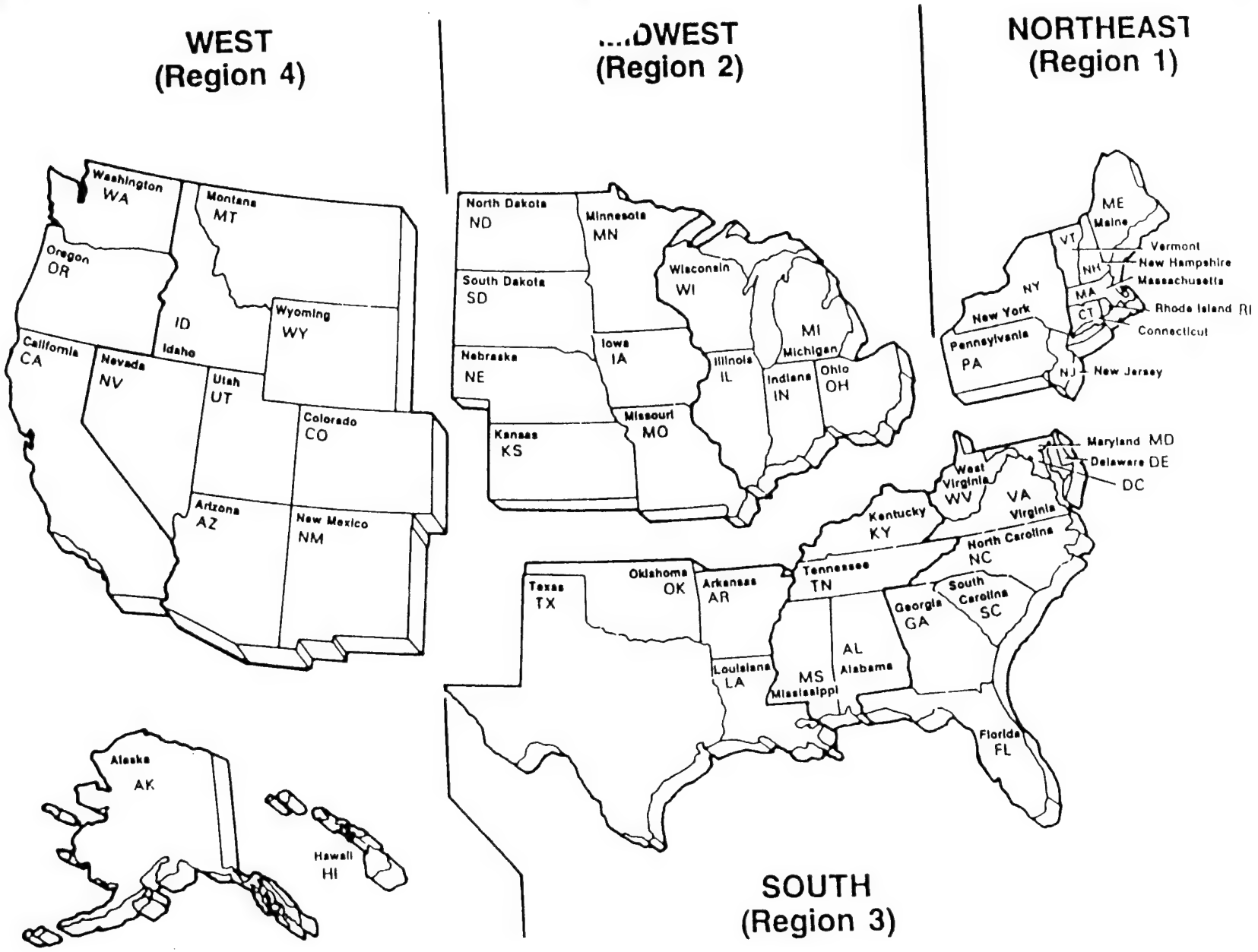
N	RESIDENTIAL ELEC	RESIDENTIAL DIST	RESIDENTIAL LPG	RESIDENTIAL NTGAS	COMMERCIAL ELEC	COMMERCIAL DIST	COMMERCIAL RESID	COMMERCIAL NTGAS	COMMERCIAL COAL	INDUSTRIAL ELEC	INDUSTRIAL DIST	INDUSTRIAL RESID	INDUSTRIAL NTGAS	INDUSTRIAL COAL	TRANSPORT GASLN	N
1	0.98	0.98	0.97	0.99	0.98	0.99	1.00	1.00	0.98	0.98	0.98	1.02	1.00	1.02	1.00	1
2	1.95	1.95	1.92	1.99	1.93	1.96	2.00	2.01	1.93	1.92	1.95	2.04	1.99	2.04	2.00	2
3	2.89	2.91	2.86	2.98	2.87	2.94	3.02	3.01	2.87	2.83	2.91	3.07	2.98	3.01	2.99	3
4	3.82	3.86	3.78	3.94	3.79	3.91	4.04	3.99	3.79	3.71	3.87	4.10	3.96	3.96	3.97	4
5	4.74	4.80	4.70	4.89	4.69	4.89	5.07	4.95	4.69	4.58	4.82	5.14	4.92	4.87	4.94	5
6	5.64	5.73	5.61	5.81	5.58	5.86	6.11	5.90	5.57	5.42	5.79	6.20	5.86	5.77	5.90	6
7	6.53	6.66	6.50	6.72	6.45	6.85	7.16	6.83	6.41	6.25	6.75	7.27	6.81	6.66	6.85	7
8	7.40	7.58	7.39	7.62	7.30	7.83	8.21	7.75	7.25	7.05	7.71	8.35	7.75	7.54	7.79	8
9	8.25	8.50	8.26	8.52	8.15	8.82	9.28	8.67	8.06	7.82	8.67	9.44	8.67	8.42	8.71	9
10	9.10	9.41	9.13	9.40	8.97	9.81	10.34	9.58	8.84	8.58	9.62	10.53	9.60	9.28	9.63	10
11	9.92	10.30	10.00	10.27	9.77	10.78	11.41	10.47	9.63	9.30	10.56	11.61	10.52	10.12	10.52	11
12	10.73	11.18	10.87	11.13	10.57	11.75	12.47	11.37	10.43	10.01	11.49	12.69	11.43	10.94	11 40	12
13	11.53	12.06	11.75	11.98	11.35	12.72	13.54	12.25	11.19	10.69	12.41	13.76	12.35	11.73	12.26	13
14	12.32	12.93	12.62	12.82	12.11	13.69	14.59	13.12	11.90	11.36	13.33	14.83	13.27	12.51	13 12	14
15	13.09	13.79	13.48	13.64	12.85	14.65	15.65	13.98	12.59	12.02	14.23	15.87	14.17	13.28	13.95	15
16	13.86	14.64	14.33	14.46	13.58	15.60	16.70	14.83	13.27	12.66	15.12	16.91	15.07	14.01	14.77	16
17	14.60	15.47	15.17	15.25	14.29	16.54	17.75	15.66	13.94	13.29	16.00	17.94	15.96	14.74	15.58	17
18	15.33	16.29	16.00	16.04	14.98	17.46	18.79	16.48	14.58	13.90	16.87	18.97	16.84	15.45	16.37	18
19	16.05	17.09	16.81	16.81	15.64	18.38	19.83	17.30	15.22	14.50	17.73	20.00	17.72	16.15	17.16	19
20	16.75	17.88	17.62	17.57	16.29	19.28	20.86	18.10	15.84	15.08	18.57	21.02	18.58	16.83	17.93	20
21	17.43	18.66	18.41	18.32	16.92	20.17	21.89	18.88	16.44	15.64	19.41	22.04	19.44	17.50	18.70	21
22	18.11	19.42	19.18	19.05	17.53	21.04	22.91	19.66	17.03	16.20	20.23	23.06	20.29	18.16	19.45	22
23	18.77	20.17	19.95	19.78	18.13	21.91	23.93	20.43	17.61	16.73	21.05	24.08	21.13	18.80	20.19	23
24	19.41	20.91	20.70	20.49	18.71	22.76	24.94	21.19	18.18	17.26	21.85	25.09	21.96	19.43	20.93	24
25	20.05	21.63	21.44	21.19	19.27	23.60	25.94	21.93	18.73	17.77	22.65	26.10	22.79	20.05	21.65	25
26/a	20.67	22.34	22.17	21.88	19.81	24.43	26.94	22.67	19.27	18.27	23.43	27.11	23.61	20.66	22.36	26
27/a	21.27	23.04	22.89	22.56	20.34	25.25	27.94	23.39	19.80	18.76	24.21	28.11	24.42	21.26	23.06	27
28/a	21.87	23.73	23.60	23.23	20.86	26.06	28.93	24.11	20.31	19.23	24.97	29.11	25.22	21.84	23.75	28
29/a	22.45	24.40	24.30	23.89	21.36	26.86	29.92	24.81	20.82	19.69	25.73	30.11	26.02	22.42	24.44	29
30/a	23.02	25.06	24.99	24.53	21.84	27.65	30.90	25.51	21.31	20.14	26.47	31.11	26.80	22.98	25.11	30

[a] UPW* factors are reported for years 26-30 to accommodate a planning/construction period of up to 5 years. (See p. 6 for instructions on use.)

Table A-2. UPV factors for finding the present value of annually recurring uniform amounts (non-fuel)

Year of Occurrence (t)	Uniform Present Value (UPV) Factors: FEMP Discount rate 3.0%	OMB Discount Rates[a] Short term[b] 2.5%	OMB Discount Rates[a] Long Term[c] 2.8%
1	0.97	0.98	0.97
2	1.91	1.93	1.92
3	2.83	2.86	2.84
4	3.72	3.76	3.73
5	4.58	4.65	4.61
6	5.42	5.51	5.45
7	6.23	6.35	6.28
8	7.02	7.17	7.08
9	7.79	7.97	7.86
10	8.53	8.75	8.62
11	9.25		9.36
12	9.95		10.07
13	10.63		10.77
14	11.30		11.45
15	11.94		12.11
16	12.56		12.76
17	13.17		13.38
18	13.75		13.99
19	14.32		14.58
20	14.88		15.16
21	15.42		15.72
22	15.94		16.26
23	16.44		16.79
24	16.94		17.31
25	17.41		17.81
26	17.88		18.30
27	18.33		18.77
28	18.76		19.23
29	19.19		19.68
30	19.60		20.12

[a] OMB discount rates as of March 1994. OMB rates are expected to be revised in February 1995.
[b] Short-term discount rate based on OMB discount rate for 7-year study period.
[c] Long-term discount rate based on OMB discount rate for 30-year study period.



Source: U.S. Bureau of the Census

Figure B-1. Map of the United States Showing Census Regions.

ECO #4: Repair Discovered Leaks

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA			2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK			4. PROJECT TITLE Repair Discovered Leaks	
5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER		8. PROJECT COST ($000)

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST
FEMP: Repair Discovered Leaks	LS			$35,674
TOTAL CONTRACT COST				35,674
SIOH (6%)				2,140
DESIGN COST (6%)				2,140
TOTAL PROJECT COST				39,955
TOTAL REQUEST (ROUNDED)				40,000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Repair sixteen leaks discovered by a leak detection survey performed on the water distribution piping system at Ft. Richardson, Alaska. These leaks consist of five main line leaks, five valve leaks, and six fire hydrant leaks. The total leakage savings that can be claimed by repairing these leaks was estimated at 234,500 gallons per day (85,592,500 gallons per year).

11. REQUIREMENT:

Project: This Federal Energy Management Program (FEMP) project will repair sixteen water distribution leaks discovered during a leak detection survey performed in June 1995 at Ft. Richardson. The project will involve repairing five main line leaks and replacing five water valves and six fire hydrants.

Requirement: This project is required to reduce water distribution leakage at Ft. Richardson. A reduction of leakage in the water distribution system would result in immediate energy and maintenance savings.

Current Situation: Ft. Richardson pumps approximately 547,462,000 gallons of water per year into the water distribution system. A leak detection survey has revealed that about 85,592,500 gallons of water (15% of total usage) is currently being lost in the form of leakage. The estimated leakage quantity is made up of five main line leaks (78,840,000 gallons per year), five valve leaks (4,562,500 gallons per year), and six hydrant leaks (2,190,000 gallons per year).

Impact If Not Provided: Failure to implement this project will cause Ft. Richardson to not realize a $61,293 annual savings with a 0.65 year simple payback and a savings-to-investment ratio of 22.83.

Supporting Documentation: Results of the leak detection survey, as well as basic engineering calculations which present energy and cost savings are documented in a report under COE Contract No. DACA01-94-D-0033, performed by an A/E firm in FY95.

Verification of Savings: Detailed annual water production and maintenance costs are recorded by Ft. Richardson. The production rate of water at Ft. Richardson is recorded from meters located at the water treatment plant. These meters are read on a monthly basis. Historic data was obtained for the period of October 1992 through April 1995 as a basis for the report mentioned above. Annual water production and maintenance costs, as well as the quantity of water produced for the period after the project is implemented, can be compared to historical data. Assuming that water demand at Ft. Richardson has remained fairly constant, the amount of water saved in repairing the leakage should be the difference.

Amount of Water Conserved: The amount of water conserved is estimated to be 85,592,500 gallons per year.

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Repair Discovered Leaks		5. PROJECT NUMBER

ECONOMIC ANALYSIS

A leak detection survey was performed on water distribution piping during June 1995 at Ft. Richardson, Alaska. By the direction of Ft. Richardson personnel, a total of 55 miles of piping was surveyed. The surveyor used a combination of listening devices and preamplified-transducer systems to identify and locate the majority of leaks.

Seventeen leaks were located during the survey. Nonvisible leaks were excavated and inspected. Leakage quantities were estimated by the technician based on the size of the leak, size of the pipe, pressure in the pipe and measurement techniques recommended by the American Water Works Association (AWWA). The total estimated leakage quantity of 238,000 gallons per day was comprised of the following:

- Five main line leaks estimated at 216,000 gallons per day
- Five valve leaks estimated at 12,500 gallons per day
- One service line leak estimated at 3,500 gallons per day
- Six fire hydrant leaks estimated at 6,000 gallons per day

It was assumed that the service line leak, which was located inside of an inaccessible building, was a water faucet that was left open to protect the water distribution system from freezing, not a leak. Therefore, its estimated leakage value was not included in the analysis.

The cost savings associated with repairing the leakage was calculated. The total cost savings equals the quantity of water saved by repairing the discovered leakage multiplied by the cost of water per gallon. The cost of water at Ft. Richardson is a combination of several factors:

- **Water Production Costs.** Water production costs consist of the material costs to operate the water treatment plant, including supplies, equipment and water treatment costs. The annual cost for production was divided by the total quantity of water produced to obtain a water production cost of $0.4047 per thousand gallons.
- **Maintenance Costs.** These costs include the labor costs associated with operating and maintaining the water distribution system and the water treatment plant. The annual cost for maintenance was divided by the total quantity of water produced for Ft. Richardson to obtain a maintenance cost of $0.3064 per thousand gallons.
- **Pump Electrical Consumption.** Three 50 hp backwash pumps operate at the water treatment plant. Three additional pumps are used periodically throughtout the year to circulate water through the distribution system and to supplement water flow. This value was calculated by taking the total annual energy consumption for these pumps divided by the total annual water consumption. Annual energy consumption was calculated based on pump operating schedules and electrical rate data provided by Ft. Richardson personnel. Water consumption was based on meter data provided by Ft. Richardson personnel. The electrical cost was calculated to be $0.005 per thousand gallons.

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Repair Discovered Leaks		5. PROJECT NUMBER

ECONOMIC ANALYSIS (cont.)

A detailed cost estimate was performed using the Micro Computer Aided Cost Engineering System (MCACES). Costs were determined for:

- Repairing main line leaks. Five leaks, in pipe ranging in size from 4 to 14 inches in diameter, were identified.
- Replacing leaking valves. Five valves, ranging in size from 4 to 10 inches in diameter, require replacement.
- Replace leaking fire hydrants. Six fire hydrants are targeted for replacement.

A life cycle cost analysis was performed to determine the economic feasibility of repairing the leaks over a 20 year economic life. The economic analysis was based only upon the leakage quantities identified by the leak detection survey.

A summary of the life cycle cost analysis, along with a summary of the leaks located by the leak detection survey, is provided on the following pages.

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Repair Discovered Leaks		5. PROJECT NUMBER

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION:	Ft. Richardson, AK	REGION: 4 (Alaska)		PROJECT NO:	1406-007
PROJECT TITLE:	Leak Detection Study			FISCAL YEAR:	1996
ANALYSIS DATE:	10/01/95	ECONOMIC LIFE:	20	PREPARED BY:	TCP

1. INVESTMENT: **ECO #4 - Repair Discovered Leaks**

A. CONSTRUCTION COST	=		$35,674	
B. SIOH COST	(6.0% of 1A) =		$2,140	
C. DESIGN COST	(6.0% of 1A) =		$2,140	
D. TOTAL COST	(1A +1B +1C) =		$39,955	
E. SALVAGE VALUE OF EXISTING EQUIPMENT =			$0	
F. PUBLIC UTILITY COMPANY REBATE =			$0	
G. TOTAL INVESTMENT	(1D -1E -1F) =		------->	$39,955

2. ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: Jan-95

ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A. ELECTRICAL	$0.005	85,593	$428	15.08	$6,454	
B. DIST	$0.05	0	$0	18.57	$0	
C. RESID	$5.00	0	$0	21.02	$0	
D. NAT GAS	$4.00	0	$0	18.58	$0	
E. COAL	$2.60	0	$0	16.83	$0	
F.						
G. TOTAL		85,593	$428		-------->	$6,454

3. NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1 PRODUCTION ($0.4047/KGAL)	$34,639	14.88	$515,436	
2 MAINTENANCE ($0.3064/KGAL)	$26,226	14.88	$390,238	
3	$0	0.00	$0	
4 TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$60,865		$905,674	

B. NON-RECURRING (+/-)

ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/ COST (4)	
a.	$0		0.000	$0	
b.	$0		0.000	$0	
c.	$0		0.000	$0	
d. TOTAL	$0			$0	

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-)	(3A4 + 3Bd4) =		$905,674
4. FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2H3 + 3A + (3Bd1/Economic Life))		$61,293
5. SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =		0.65
6. TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =		$912,128
7. DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =		22.83

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Repair Discovered Leaks		5. PROJECT NUMBER

RESULTS OF LEAK DETECTION SURVEY

LEAK NO.	TYPE OF LEAK	LOCATION/ DESCRIPTION	SIZE (GPD)	PIPE/VALVE SIZE
F3-1	Main Line	National Cemetary	72,000	4" Line
F3-2	Main Line	National Cemetary	36,000	4" Line
F3-3	Valve (Packing)	Randall Road @ Stambone Road	2,500	6" Valve
F3-4	Fire Hydrant	Hydrant #57-24, Stambone Road	1,000	
F3-5	Fire Hydrant	Hydrant #8-66, Near Bldg. #932	1,000	
F3-6	Fire Hydrant	Hydrant #57-1, Randall Road @ Davis Hwy.	1,000	
F4-1	Valve (Packing)	Davis Hwy @ VA Entrance	2,500	10" Valve
G2-1	Service Line	Bldg. #45070, Circle Drive	3,500	Leak is inside bldg.
G3-1	Main Line	Warehouse Street @ Bldg. #984	36,000	8" Line
G3-2	Main Line/Valve	1st Street @ D Street	36,000	14" Line
G3-3	Fire Hydrant	Hydrant #7-8, Near Bldg. #796	1,000	
G3-4	Valve (Packing)	2nd Street @ C Street, Near Bldg. #626	2,500	10" Valve
G3-5	Valve (Packing)	6th Street @ Akutan Ave, Near Bldg. #205	2,500	4" Valve
G3-6	Valve (Packing)	6th Street @ Beluga Ave, Near Bldg. #226	2,500	8" Valve
G3-7	Fire Hydrant	Hydrant #1-16, Near 105A Gulkana	1,000	
G3-8	Fire Hydrant	Hydrant #3-20, 5th Street @ Juneau Ave.	1,000	
G3-9	Main Line	Frontage Road @ Arctic Valley Road	36,000	14" Line

LEAK SUMMARY

Leak Type	No. of Leaks	Size (GPD)	Size (KGAL/YR)
Main Line	5	216,000	78,840
Service Line	1	3,500	1,278
Valve (Packing)	5	12,500	4,563
Fire Hydrant	6	6,000	2,190
Total	17	238,000	86,870

Assume service line leak, which was located in an inaccessible building, was simply a water faucet opened to protect the water distribution piping from freezing, not a leak. Total leakage in the distribution system was assumed to be 234,500 GPD (85,593 kGal/year).

Ft Richardson Water - ECO #4
Water Conservation Study
Repair Discovered Leaks
Leak Detection Survey
June 1995

Designed By: MJS
Estimated By:

Prepared By: TCP

Preparation Date: 07/14/95
Effective Date of Pricing: 07/14/95

Sales Tax: 0.00%

E-6

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

		QUANTITY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST	UNIT COST
01	Water Supply & Distribution	1.00	LF	9,055	153	6,882	667	16,604	16603.71
02	Site Demolition & Relocation	1.00	SY	0	56	2,354	431	2,785	2785.31
03	Site Earthwork	1.00	CY	1,420	167	3,488	961	5,869	5868.69
TOTAL	Ft Richardson Water - ECO #4	1.00	EA	10,475	376	12,724	2,059	25,258	25257.71
	Contractor's Overhead							3,789	
	SUBTOTAL							29,046	
	Contractor's Profit							2,905	
	SUBTOTAL							31,951	
	Contractor's Bond							479	
	TOTAL INCL INDIRECTS							32,430	
	Contingency							3,243	
	TOTAL INCL OWNER COSTS							35,673	

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01.02. Potable Water Distribution			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
01. Water Supply & Distribution Systems									
01.02. Potable Water Distribution									
M MIL AA <15109 2102 >	6" Standard Fire Hydrant One Piece w/5'(1.5M)Burial Secti		6.00	EA	3,679	48	1,838	20	5,538
M MIL AA <02455 1002 >	6" Dia Mechanical Joint, DI Pipe (15cm) Diameter, No Fittings		10.00	LF	105	2	71	13	189
USR AA < >	Patch Pipe Leaks		5.00	EA	1,250	0	1,000	0	2,250
M MIL AA <02555 3001 >	4"(10cm) Cast Iron Gate Valve Includes Box		1.00	EA	380	11	429	78	887
M MIL AA <02555 3002 >	6"(15cm) Cast Iron Gate Valve Includes Box		1.00	EA	493	15	571	105	1,169
M MIL AA <02555 3003 >	8"(21cm) Cast Iron Gate Valve Includes Box		1.00	EA	766	18	686	126	1,577
M MIL AA <02555 3004 >	10"(25cm) Cast Iron Gate Valve Includes Box		2.00	EA	2,382	60	2,286	325	4,993
	TOTAL	Potable Water Distribution			9,055	153	6,882	667	16,604
	TOTAL	Water Supply & Distribution			9,055	153	6,882	667	16,604

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02.03. Underground Site Demolition			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
02. Site Demolition & Relocation This includes the demolition and/or relocation of structures, pavements, fencing, and underground utilities. Disposal of debris or demolished material, including loading and hauling, is also included.									
02.03. Underground Site Demolition									
	CIV AA <02112 8007 >	Demo Fire Hydrants Remove Only	6.00	EA	0	53	2,057	377	2,433
	CIV AA <02112 8006 >	Demo Welded St Pipe 6" to 12" D Sewer/Water Pipe, No Excavation	10.00	LF	0	3	122	22	145
	USR AA < >	Fire Hydrant Replacement Demo Iron Valve 6" to 12" D Valve replacement	5.00	LF	0	0	175	32	207
	TOTAL	Underground Site Demolition			0	56	2,354	431	2,785
	TOTAL	Site Demolition & Relocation			0	56	2,354	431	2,785

03.02. Common Excavation & Disposal			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
03. Site Earthwork									
03.02. Common Excavation & Disposal									
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	200.00	CY	0	3	140	170	310
		Excavation for hydrant leaks							
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	200.00	CY	0	3	140	170	310
		Excavation for Main Leaks							
	MIL AA <02221 1604 >	Trench, 2 CY Hyd Excav, Lse Rock 115 CY/Hr (88M3)	80.00	CY	0	1	56	68	124
		Valve Replacement							
	TOTAL	Common Excavation & Disposal			0	8	337	407	744
03.04. Fill & Borrow									
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader	50.00	CY	676	55	290	105	1,071
		For hydrant replacement							
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	150.00	CY	0	3	129	78	206
		For hydrant replacement							
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader	50.00	CY	676	55	290	105	1,071
		For main line leak repair							
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	150.00	CY	0	3	129	78	206
		For Main Line Leak repair							
	M USR AA <02221 8001 >	Sand Bedding w/Sm FEnd Loader	5.00	CY	68	6	29	11	107
		Valve replacement							
	MIL AA <02221 5003 >	Backfill Trench w/Sm FEnd Loader Without Compaction	75.00	CY	0	2	64	39	103
		Valve Replacement							
	TOTAL	Fill & Borrow			1,420	124	930	415	2,765
03.05. Compaction									
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers	200.00	CY	0	15	549	14	563
		For hydrant replacement							
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate 15cm) Layers	200.00	CY	0	15	549	14	563
		For main line leak repair							

03.05. Compaction			QUANTY	UOM	MATERIAL	MANHRS	LABOR	EQUIPMNT	TOTAL COST
	MIL AA <02221 7002 >	Compaction, 6" Layers, Vib Plate (15cm) Layers Valve replacement	80.00	CY	0	6	220	6	225
	TOTAL	Compaction			0	36	1,317	34	1,351
03.10. Temporary Dewatering									
	USR AA <	> Dewatering For hydrant replacement	3.00	DAY	0	0	209	24	233
	USR AA <	> Dewatering For main line leak repair	7.00	DAY	0	0	487	56	543
	USR AA <	> Dewatering Valve replacement	3.00	DAY	0	0	209	24	233
	TOTAL	Temporary Dewatering			0	0	904	105	1,008
	TOTAL	Site Earthwork			1,420	167	3,488	961	5,869
	TOTAL	Ft Richardson Water - ECO #4			10,475	376	12,724	2,059	25,258

E-12

ECO #5: Implement Leak Detection Program

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA			2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK			4. PROJECT TITLE Implement Leak Detection Program	
5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER		8. PROJECT COST ($000)

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST
FEMP: Implement Leak Detection Program	LS			$21,250
TOTAL CONTRACT COST				21,250
SIOH (6%)				1,275
DESIGN COST (6%)				1,275
TOTAL PROJECT COST				23,800
TOTAL REQUEST (ROUNDED)				24,000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Implement a water audit and leak detection program for approximately 85 miles of water distribution piping at Ft. Richardson, Alaska.

11. REQUIREMENT:

Project: This Federal Energy Management Program (FEMP) project will implement a leak detection program for the water distribution system at Ft. Richardson.

Requirement: This project is required to reduce water usage at Ft. Richardson. A reduction of leakage in the water distribution system would result in immediate energy and maintenance savings.

Current Situation: Ft. Richardson pumps approximately 547,462,000 gallons of water per year into the water distribution system. A water audit has calculated that about 49,383,550 gallons of water (9%) is in the form of leakage that can be recovered. It is Ft. Richardson's policy that leakage that is discovered in a leak detection survey will be immediately excavated and repaired.

Impact If Not Provided: Failure to implement this project will cause Ft. Richardson to not realize a $35,364 annual savings with a simple payback of 0.67 years and a savings-to-investment ratio of 22.11.

Supporting Documentation: Supporting data for basic engineering calculations which show energy savings and cost savings are documented in a report under COE Contract No. DACA01-94-D-0033, performed by an A/E firm in FY95.

Verification of Savings: Detailed annual water production and maintenance costs are recorded by Ft. Richardson. The production rate of water at Ft. Richardson is recorded from meters located at the water treatment plant. These meters are read on a monthly basis. Historic data was obtained for the period of October 1992 through April 1995 as a basis for the report mentioned above. Annual water production and maintenance costs, as well as the quantity of water produced for the period after the project is implemented, can be compared to historical data. Assuming that water demand at Ft. Richardson has remained fairly constant, the amount of water saved in repairing the leakage should be the difference.

Amount of Water Conserved: The amount of water conserved is estimated to be 49,383,550 gallons per year.

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Implement Leak Detection Program		5. PROJECT NUMBER

ECONOMIC ANALYSIS

A water audit was performed on the water distribution system at Ft. Richardson according to the guidelines set by American Water Works Association (AWWA) Manual 36, entitled "Water Audits and Leak Detection". The audit was based on information supplied by Ft. Richardson personnel. Water usage at Ft. Richardson can be separated into the following categories:

- **Domestic Water Consumption.** The amount of water consumed by all military and civilian occupants of Ft. Richardson was estimated. Demographic data, obtained from Ft. Richarson personnel, presents a detailed count of the number of people who use and occupy the base. According to guidelines in the Army Technical Manual TM 5-813-1, "Water Supply Sources and General Considerations", the design allowances for water consumption are 150 gallons per day (gpd) per person for residents and 50 gpd for non-residents. Multiplying these design allowances by the number of residents and non-residents produces an estimate of the amount of water consumed for domestic use.
- **Fire Protection**. Ft. Richardson is served by 421 fire hydrants, which are each tested for approximately 5 minutes each summer. The product of the hydrant flow rate and test length was calculated to be the total water usage per year.
- **Industrial Uses**. Potable water is used as makeup water to the electrical and steam plants. The quantity of water used by each plant was provided by Ft. Richardson.
- **Street Cleaning**. The Roads and Grounds Department at Ft. Richardson use potable water to wash streets. The amount of water used was estimated by Ft. Richardson personnel.
- **Irrigation Water.** From mid-May to September, water from the distribution system is used to irrigate the golf course, cemetary, and athletic fields at Ft. Richardson. The areas are supplied by three 2-1/2 inch and three 4 inch diameter water lines, which supply an estimated 800 gpm. It was assumed that the full capacity of the water lines feeding these areas is used for approximately four hours per day.
- **Discovered Leaks**. Ft. Richardson has maintained a record of the water line breaks that have been repaired. The amount of water that is annually lost through these line breaks was estimated. During the summer of 1994, six water line breaks were repaired on pipe lines ranging in size from 6 to 20 inches. Assumptions were made for the amount of water lost (in gpm) and the number of days required to discover and repair the leaks.

The results of the water audit are given on page 5. The amount of recoverable leakage, which is estimated as 75% of the potential water system leakage, was calculated to be 49,383,550 gallons per year. This value represents approximately 9% of Ft. Richardson's total water production.

The total beneficial value of repairing recoverable leakage was calculated. Beneficial value is calculated by multiplying the amount of leakage saved times the cost of water. The cost of water at Ft. Richardson is a combination of several factors:

- **Water Production Costs.** Water production costs consist of the material costs to operate the water treatment plant, including supplies, equipment and water treatment costs. The annual

ECONOMIC ANALYSIS (cont.)

cost for production was divided by the total quantity of water produced to obtain a water production cost of $0.4047 per thousand gallons.

- **Maintenance Costs.** These costs include the labor costs associated with operating and maintaining the water distribution system and the water treatment plant. The annual cost for maintenance was divided by the total quantity of water produced for Ft. Richardson to obtain a maintenance cost of $0.3064 per thousand gallons.
- **Pump Electrical Consumption.** Three 50 hp backwash pumps operate at the water treatment plant. Three additional pumps are used periodically throughtout the year to circulate water through the distribution system and to supplement water flow. This value was calculated by taking the total annual energy consumption for these pumps divided by the total annual water consumption. Annual energy consumption was calculated based on pump operating schedules and electrical rate data provided by Ft. Richardson personnel. Water consumption was based on meter data provided by Ft. Richardson personnel. The electrical cost was calculated to be $0.005 per thousand gallons.

The total beneficial cost of performing a leak detection survey to recover leakage from the water distribution system was assumed to be only the costs that vary with the amount of water delivered. These include the production, maintenance and energy costs. The cost of leak repair is not included. According to AWWA Manual 36, because leaks are continually discovered and repaired in the normal course of operations, the leaks found in the leak detection program would be repaired eventually. If the leaks are repaired as part of a leak detection program, as is Ft. Richardson's policy, the expense of repairing leaks as they are accidentally discovered is avoided. Although some cost savings would be realized in fixing the leaks when they are discovered by a leak detection program, as opposed to discovering them accidentally, AWWA Manual 36 allows the auditor to assume that the savings is negligible.

The total payback of the leak detection program was calculated by dividing the total cost of the leak detection program by the cost savings of recovering leakage. The total cost of the leak detection survey was taken from the average cost of the previous leak detection survey at Ft. Richardson and from cost information provided by AWWA. The cost of leak detection was given as $250 per mile of pipe surveyed. Approximately 85 miles of piping in the water distribution system would need to be investigated.

A summary of the water audit, along with the LCCA, is provided on the following pages.

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Implement Leak Detection Program		5. PROJECT NUMBER

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION:	Ft. Richardson, AK	REGION: 4 (Alaska)		PROJECT NO:	1406-007
PROJECT TITLE:	Leak Detection Study			FISCAL YEAR:	1996
ANALYSIS DATE:	10/01/95	ECONOMIC LIFE:	20	PREPARED BY:	TCP

1. INVESTMENT: **ECO #5 - Implement Leak Detection Program**

A. CONSTRUCTION COST	=		$21,250	
B. SIOH COST	(6.0% of 1A) =		$1,275	
C. DESIGN COST	(6.0% of 1A) =		$1,275	
D. TOTAL COST	(1A +1B +1C) =		$23,800	
E. SALVAGE VALUE OF EXISTING EQUIPMENT =			$0	
F. PUBLIC UTILITY COMPANY REBATE =			$0	
G. TOTAL INVESTMENT	(1D -1E -1F) =		------->	$23,800

2. ENERGY SAVINGS (+) OR COST (-):

DATE OF NISTR 85-3273-9 USED FOR DISCOUNT FACTORS: BOD Oct 1994

	ENERGY SOURCE	FUEL COST $/KGAL (1)	SAVINGS KGAL/YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)	
A.	ELECTRICAL	$0.005	49,384	$247	15.08	$3,724	
B.	DIST	$0.05	0	$0	18.57	$0	
C.	RESID	$5.00	0	$0	21.02	$0	
D.	NAT GAS	$4.00	0	$0	18.58	$0	
E.	COAL	$2.60	0	$0	16.83	$0	
F.							
G.	TOTAL		49,384	$247		-------->	$3,724

3. NON-ENERGY SAVINGS (+) OR COST (-)

A. ANNUAL RECURRING (+/-)

1 PRODUCTION ($0.4047/KGAL)	$19,986	14.88	$297,387	
2 MAINTENANCE ($0.3064/KGAL)	$15,131	14.88	$225,153	
3	$0	0.00	$0	
4 TOTAL ANNUAL DISC. SAVINGS (+) / COST (-)	$35,117		$522,540	

B. NON-RECURRING (+/-)

ITEM	SAVINGS (+) COST(-) (1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (3) (TABLE A-2)	DISCOUNTED SAVINGS/ COST (4)	
a.	$0		0.000	$0	
b.	$0		0.000	$0	
c.	$0		0.000	$0	
d. TOTAL	$0			$0	

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (+) OR COST (-) (3A4 + 3Bd4) = $522,540

4. FIRST YEAR DOLLAR SAVINGS (+) / COSTS (-)	(2H3 + 3A + (3Bd1/Economic Life))		$35,364
5. SIMPLE PAYBACK (SPB) IN YEARS (MUST BE < 10 YEARS TO QUALIFY)	(1G/4) =		0.67
6. TOTAL NET DISCOUNTED SAVINGS	(2H5 + 3C) =		$526,264
7. DISCOUNTED SAVINGS-TO-INVESTMENT RATIO (SIR) (MUST HAVE SIR > 1.25 TO QUALIFY)	(6/1G) =		22.11

1. COMPONENT ARMY	FY 1995 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Oct-95
3. INSTALLATION AND LOCATION Ft. Richardson, AK		
4. PROJECT TITLE Implement Leak Detection Program		5. PROJECT NUMBER

WATER AUDIT

Total Amount of Water Produced:		1,554,818,000
System Losses (5%):	-	77,741,000
Quantity Used:		1,477,077,000
Furnished to Elemendorf AFB:	-	929,615,000
Total Amount of Water Produced for Ft. Richardson (metered):		**547,462,000**

Unmetered Water Uses (From 1994 data provided by Ft. Richardson):

Domestic Water Consumption:	=	414,558,800
Fire Hydrant Testing:	=	789,470
Electrical Plant:	=	11,564,000
Steam Plant:	=	14,745,000
Street Cleaning:	=	1,800,000
Discovered Leaks (by maintenance personnel, not leak detection survey):	=	15,120,000
Irrigation:	=	23,040,000
Total Identified Water Losses:		**481,617,270**

Potential Water System Leakage:	(Water Produced - Identified Water Losses)		**65,844,730**
Recoverable Leakage (AWWA Manual 36 estimates 75% is recoverable):			**49,383,548**
Cost of Water Supply (per 1000 gallons):			**$0.716**
One Year Benefit from Recoverable Leakage:			**$35,364**
Total Cost of Leak Detection Program:	($250 / mile x 85 miles) + SIOH + Design Cost	=	**$23,800**
Benefit to Cost Ratio:	(For one-year program)		**1.49**
Simple Payback (years):			**0.67**

WATER AUDIT WORKSHEET

For: Ft. Richardson, AK Audit Study Period: Oct 1993 - Sep 1994

Line	Item	Water Volume: Subtotal	Water Volume: Total Cumulative	Water Volume: Units*
Task 1—Measure Supply				
1	Uncorrected total water supply to the distribution system (total of master meters)	1,554,818		KGAL/YR
2A-C	Adjustments to total water supply			"
2A	Source meter error (+ or –)	-77,741		
2B	Change in reservoir and tank storage (+ or –)			
2C	Other contributions or losses (+ or –)			
3	Total adjustments to total water supply (add lines 2A, 2B, and 2C)			
4	Adjusted total water supply to the distribution system (add line 1 and line 3)		1,477,077	"
Task 2—Measure Metered Use				
5	Uncorrected total metered water use Elemendorf	929,615		"
6	Adjustments due to meter reading lag time (+ or –)			
7	Metered deliveries (add lines 5 and 6)			
8A-C	Total sales meter error and system-service meter errors (+ or –)			
8A	Residential meter error			
8B	Large meter error			
8C	Total (add line 8A and 8B)			
9	Corrected total metered water deliveries (add lines 7 and 8C)			
10	Corrected total unmetered water (subtract line 9 from line 4)		547,462	"
11A-M	Authorized unmetered water uses			
11A	Firefighting and firefighting training	789		"
11B	~~Main flushing~~ Domestic Use	44,559		"

NOTE: 1 ac-ft = 43,560 ft^3 = 325,851 gal.

*Units of measure must be consistent throughout the worksheet. The particular unit used (that is, acre-feet, millions of gallons, cubic feet, cubic metres, or other unit) is left to the user.

Form continues on next page.

Line	Item	Water Volume: Subtotal	Water Volume: Total Cumulative	Water Volume: Units*
11A-M	Authorized unmetered water uses (continued)			
11C	Storm drain flushing			
11D	Sewer cleaning			
11E	Street cleaning	1,800		KGAL/YR
11F	Schools			
11G	Landscaping in large public areas:			
	Parks			
	Golf courses	13,680		"
	Cemeteries	6,048		"
	Playgrounds	1,548		"
	Highway median strips			
	Other landscaping	1,764		"
11H	Decorative water facilities			
11I	Swimming pools			
11J	Construction sites			
11K	Water quality and other testing (pressure testing pipe, water quality, etc.)			
11L	Process water at ~~treatment~~ Steam plants	26,309		"
11M	Other unmetered uses			
12	Total authorized unmetered water (add lines 11A through 11M)	466,497		"
13	Total water losses (subtract line 12 from line 10)		80,965	"
14A-H	Identified water losses			
14A	Accounting procedure errors			
14B	Illegal connections			
14C	Malfunctioning distribution system controls			
14D	Reservoir seepage and leakage			
14E	Evaporation			

NOTE: 1 ac-ft = 43,560 ft^3 = 325,851 gal.

*Units of measure must be consistent throughout the worksheet. The particular unit used (that is, acre-feet, millions of gallons, cubic feet, cubic metres, or other unit) is left to the user.

Form continues on next page.

Line	Item	Water Volume: Subtotal	Water Volume: Total Cumulative	Water Volume: Units*
14A-H	Identified water losses (continued)			
14F	Reservoir overflow			
14G	Discovered leaks	15,120		KGAL/yr.
14H	Theft			
15	Total identified water losses (add lines 14A through 14H)		15,120	"
16	Potential water system leakage (subtract line 15 from line 13)		65,845	"
17	Recoverable leakage (multiply line 16 by 0.75)		49,384	"

Line	Item	Dollars per Unit of Volume
18A-B	Cost savings	
18A	Cost of water supply	$0.005/KGAL
18B	Variable operation and maintenance costs	$0.7111/KGAL
19	Total costs per unit of recoverable leakage (add line 18A and line 18B)	$0.7161/KGAL

Line	Item	Dollars per Year
20	One-year benefit from recoverable leakage (multiply line 17 by line 19)	$35,364
21	Total benefits from recovered leakage (multiply line 20 by 2)	$70,728
22	Total costs of leak detection project	$23,800
23	Benefit to cost ratio (divide line 21 by line 22)	2.97

Prepared by:

Name Tom Poeling

Title EMC Engineers, Inc.

Date 7/26/95

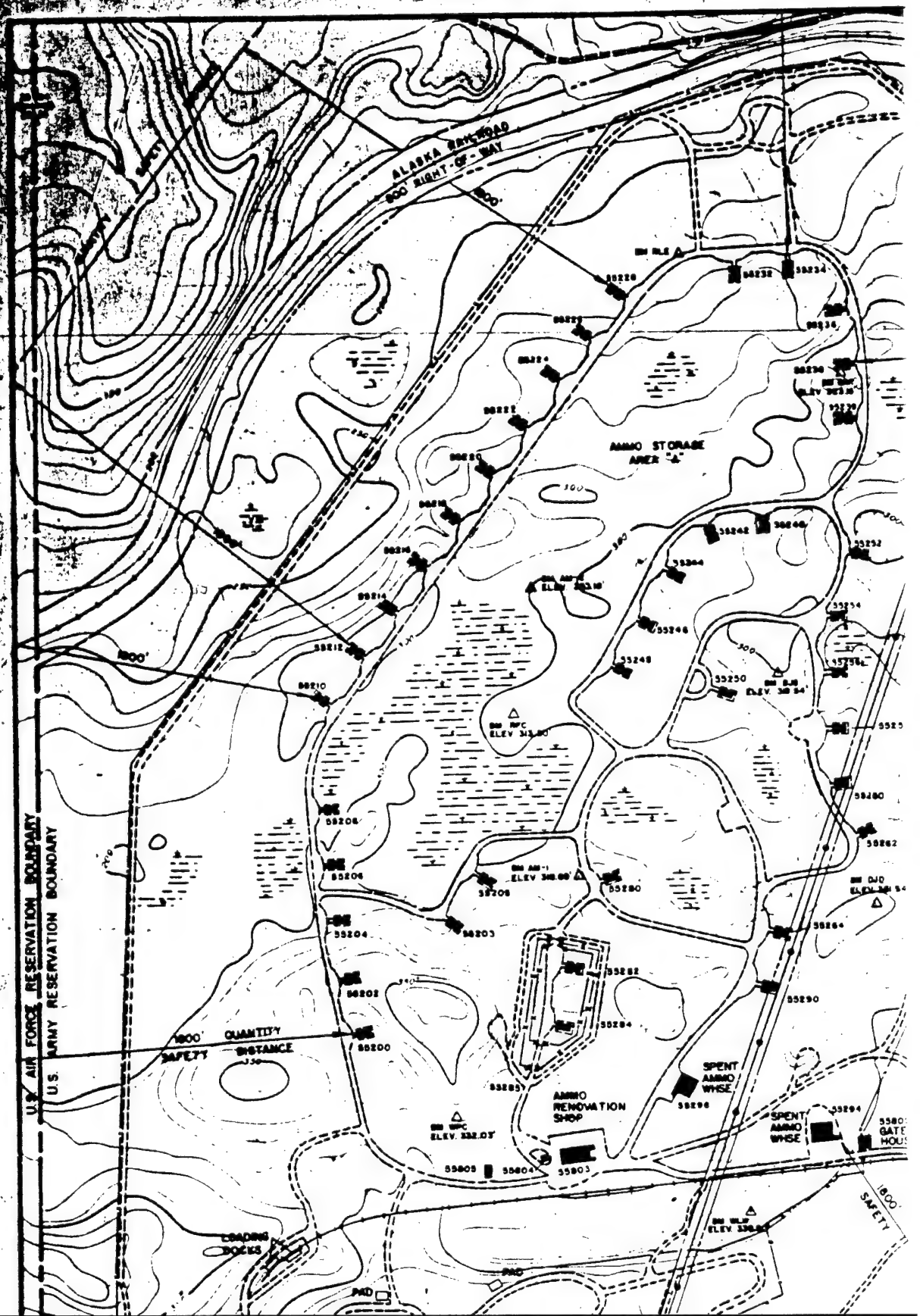
NOTE: 1 ac-ft = 43,560 ft^3 = 325,851 gal.

*Units of measure must be consistent throughout the worksheet. The particular unit used (that is, acre-feet, millions of gallons, cubic feet, cubic metres, or other unit) is left to the user.

(1)

EXHIBIT I

CORPS OF ENGINEERS



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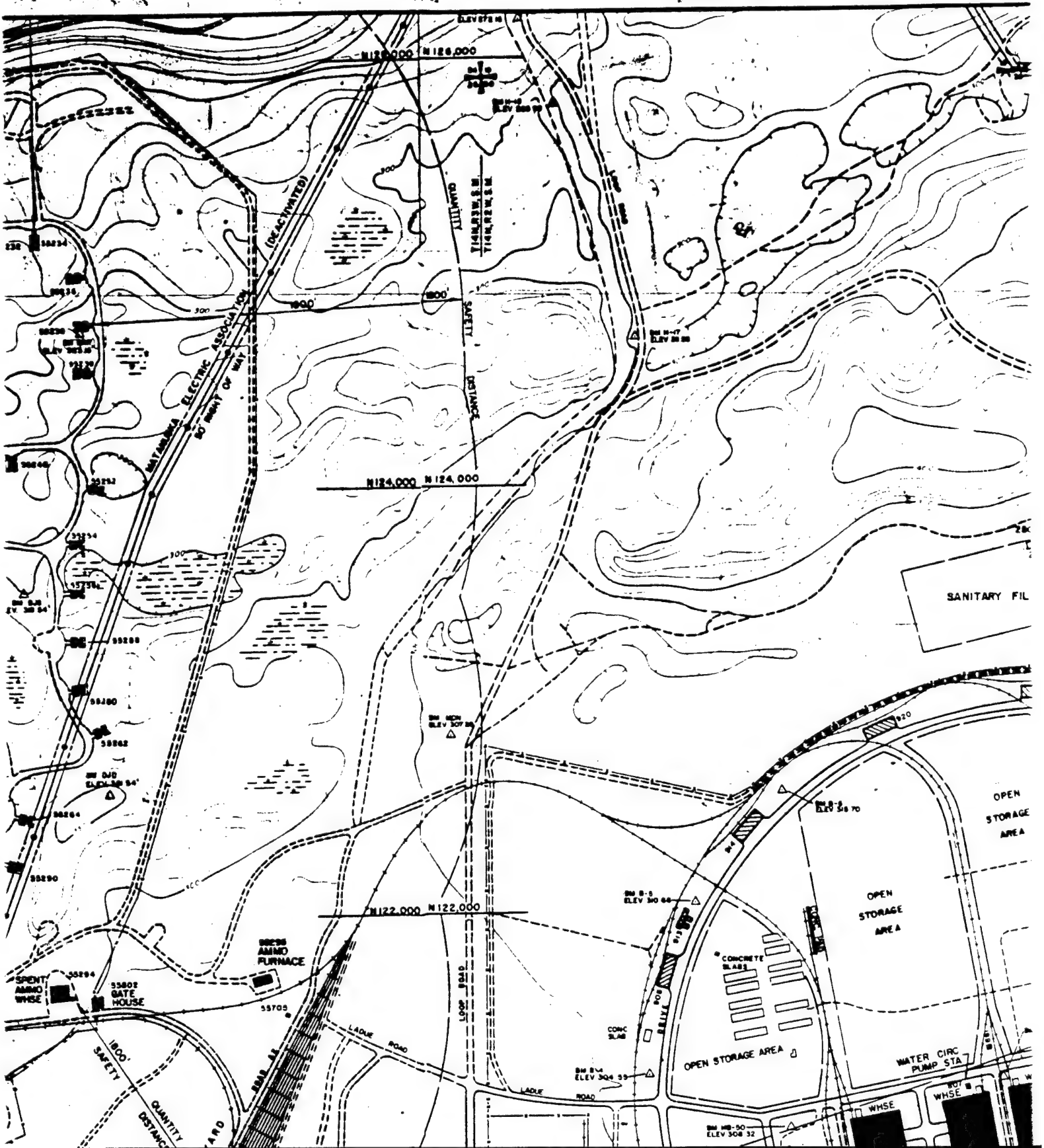

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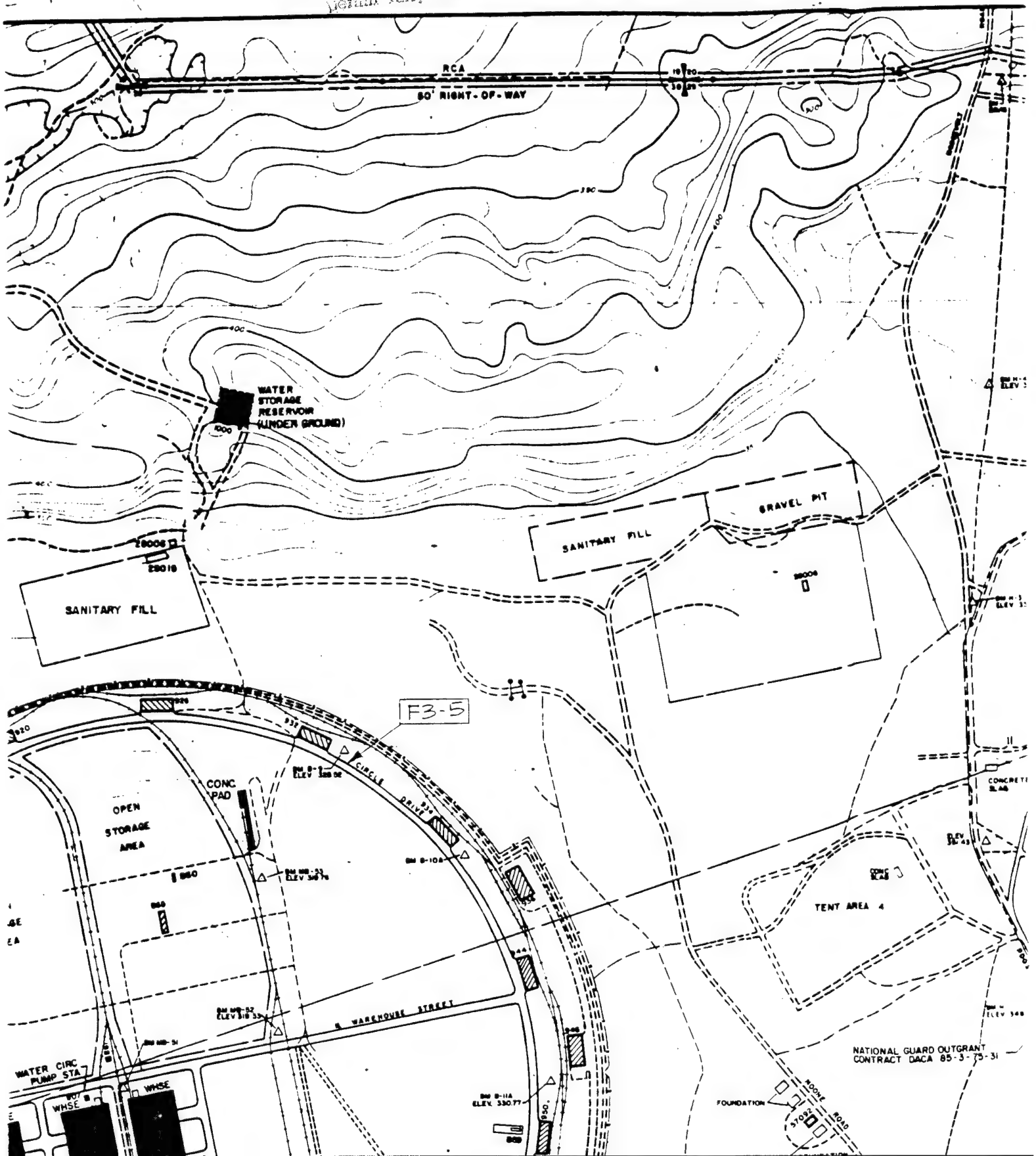
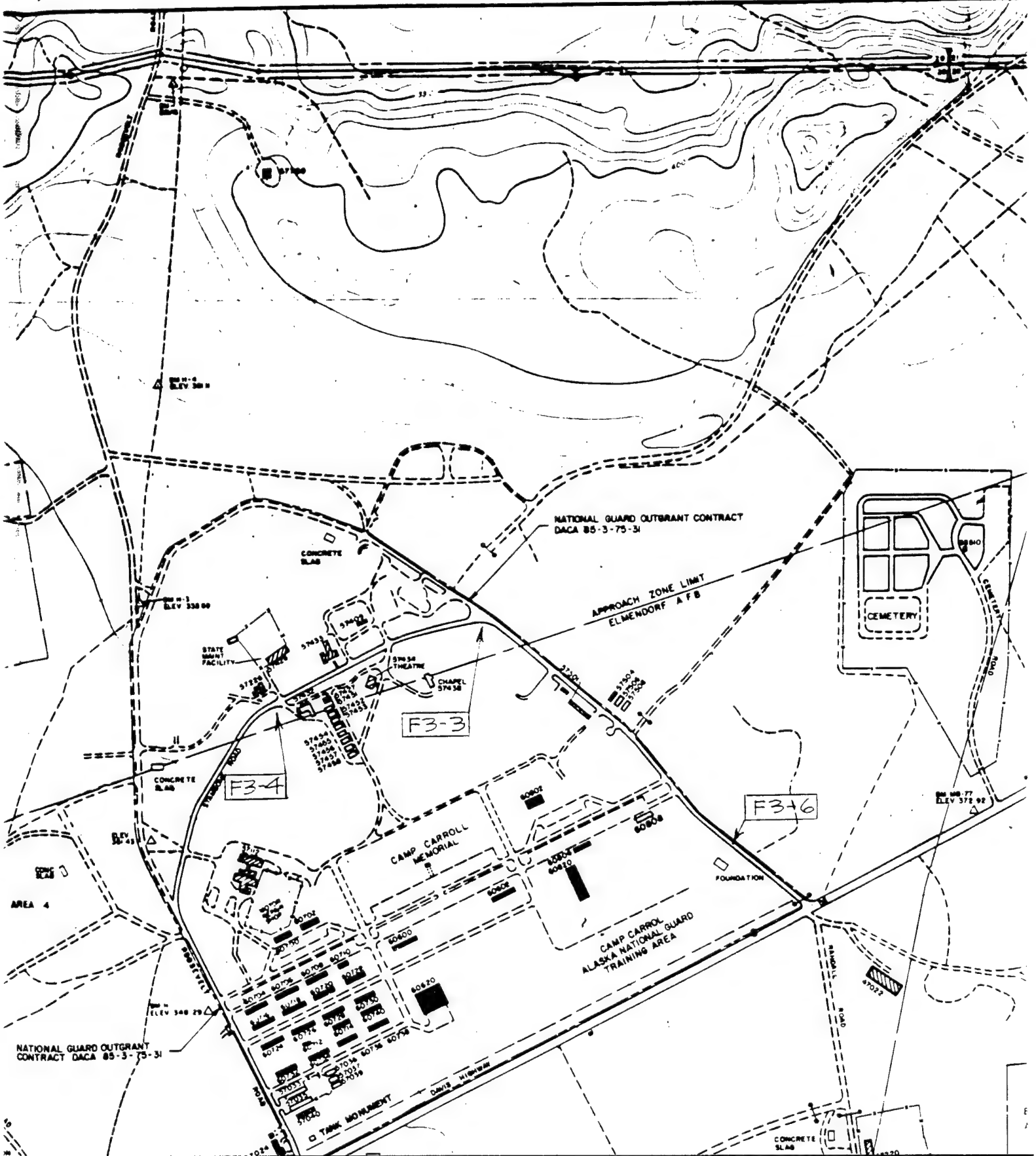
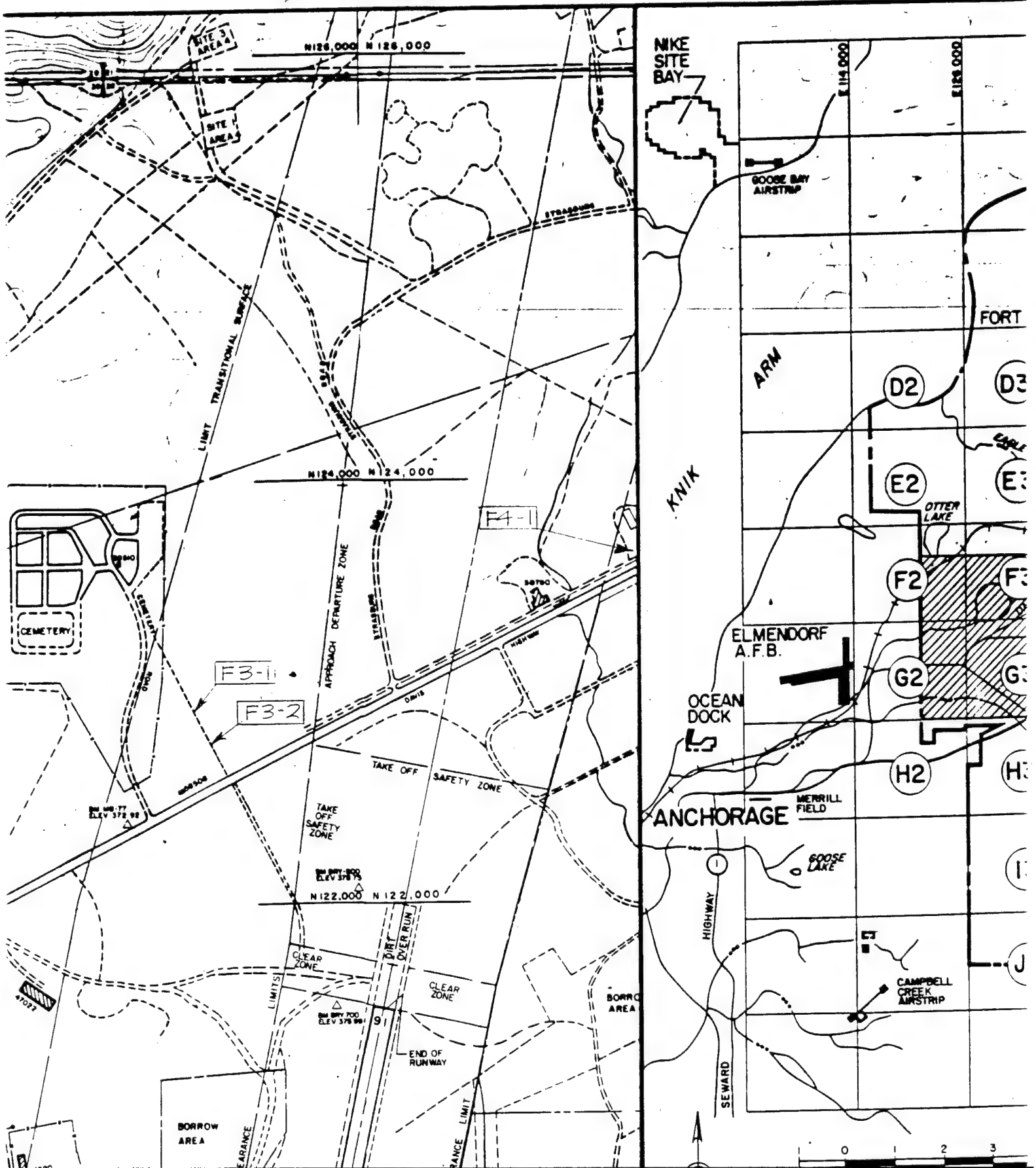
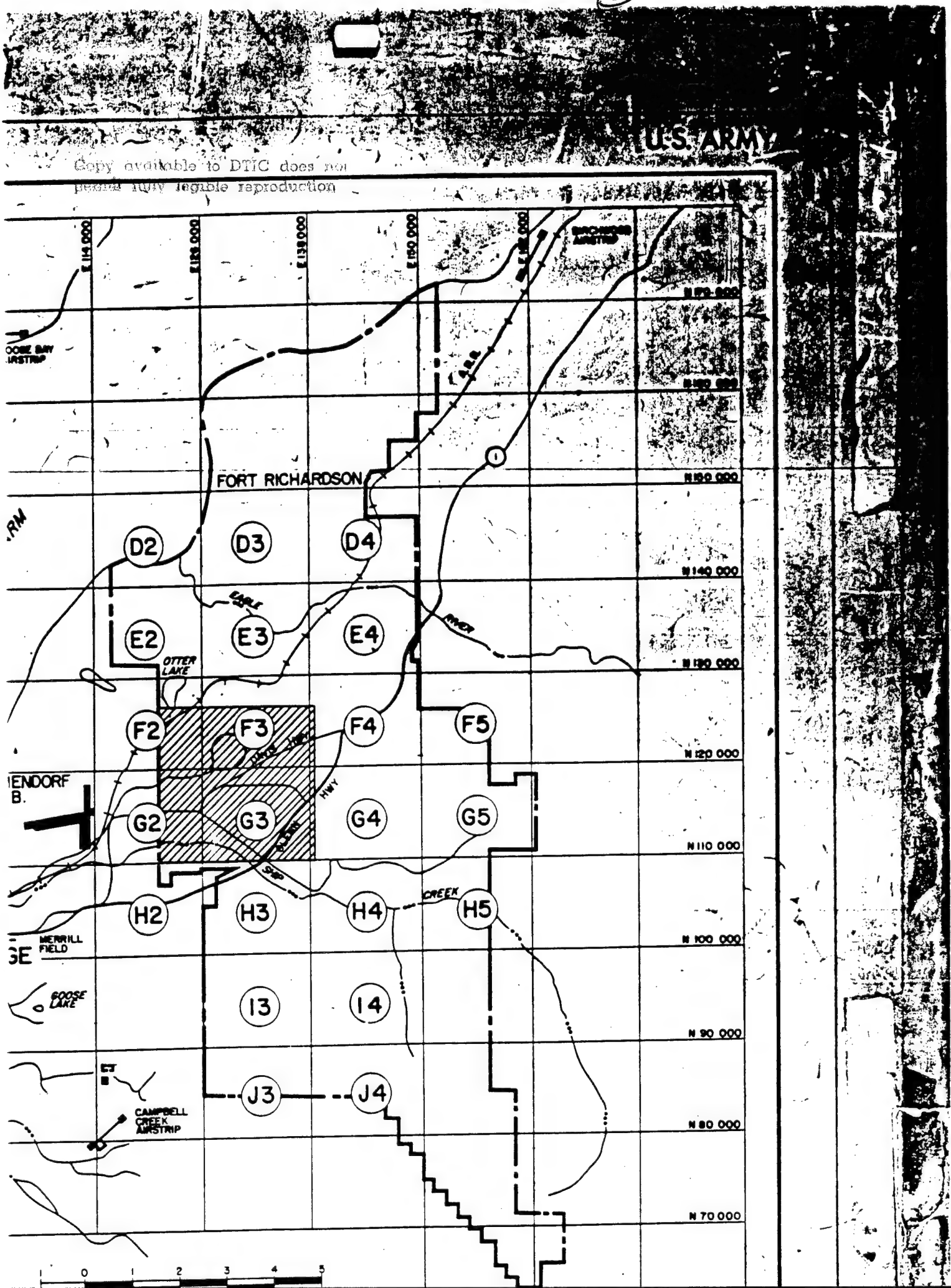
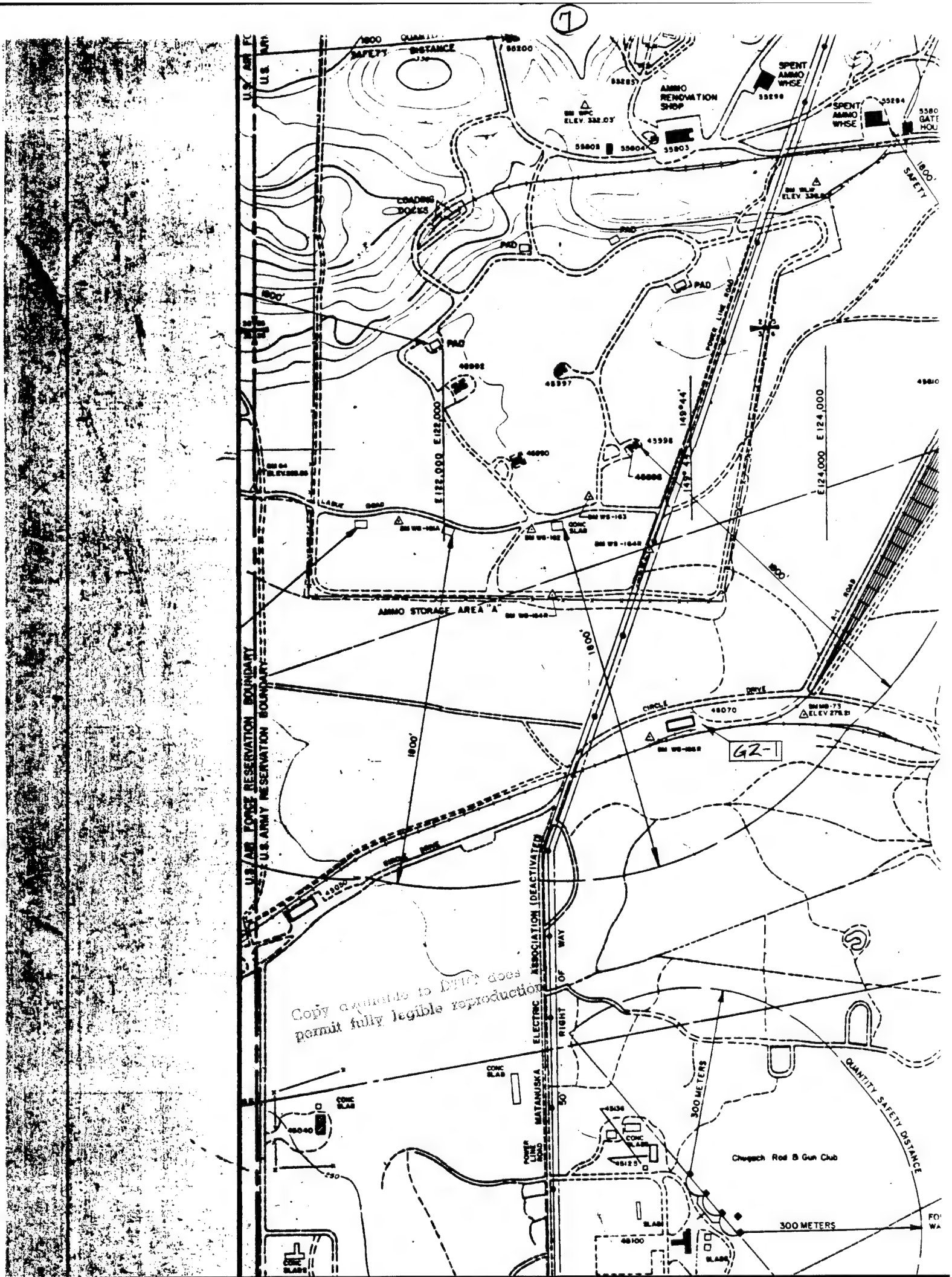
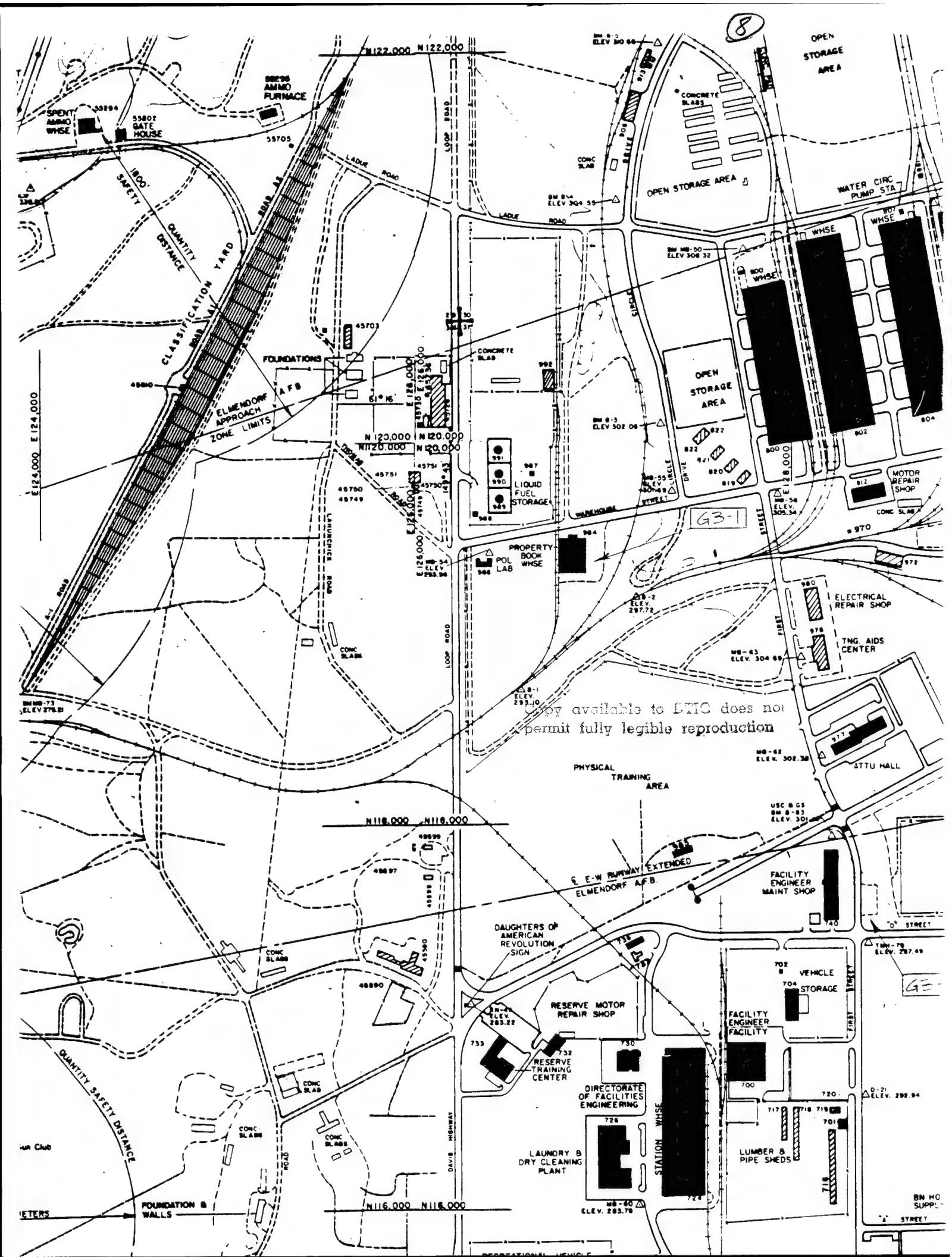


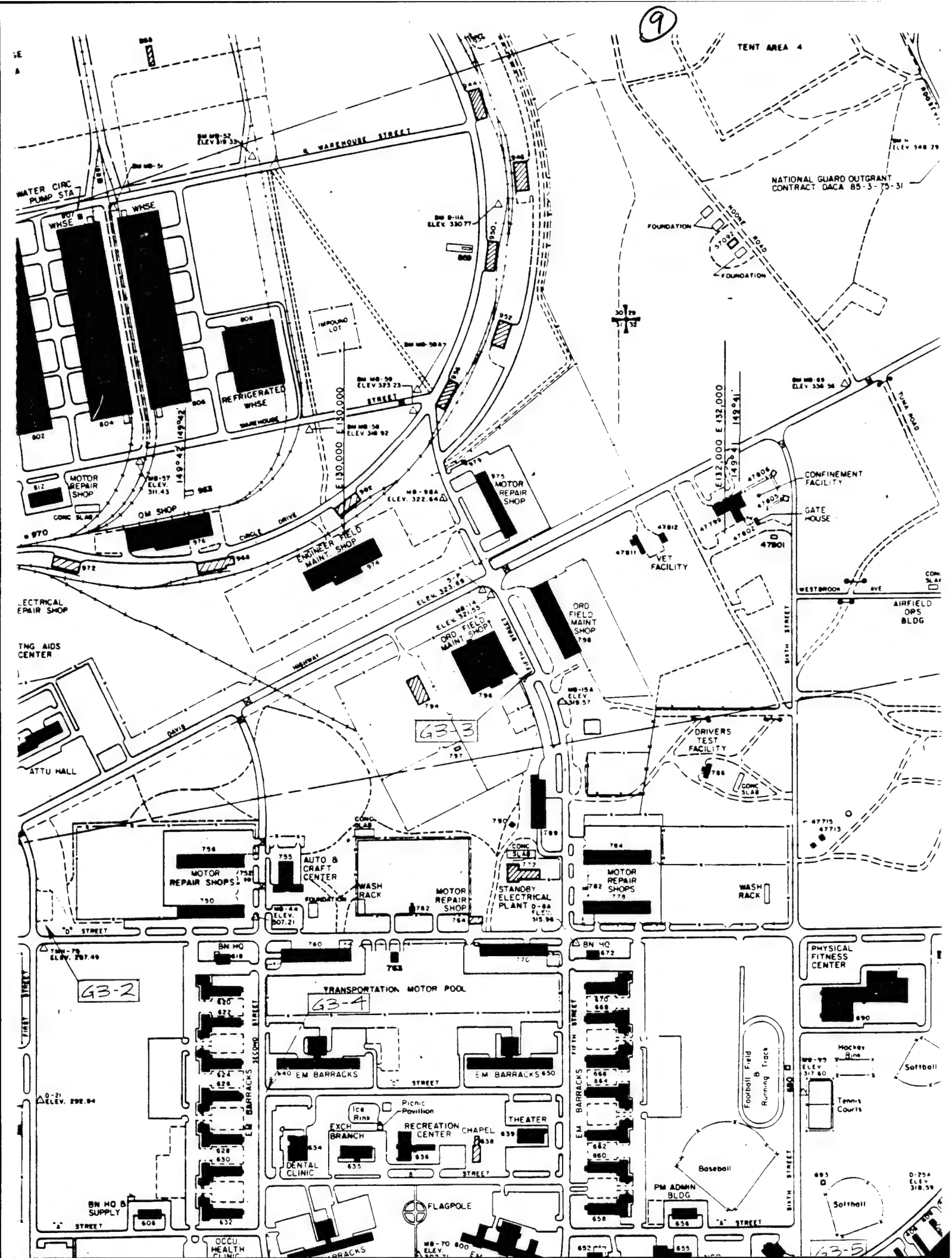


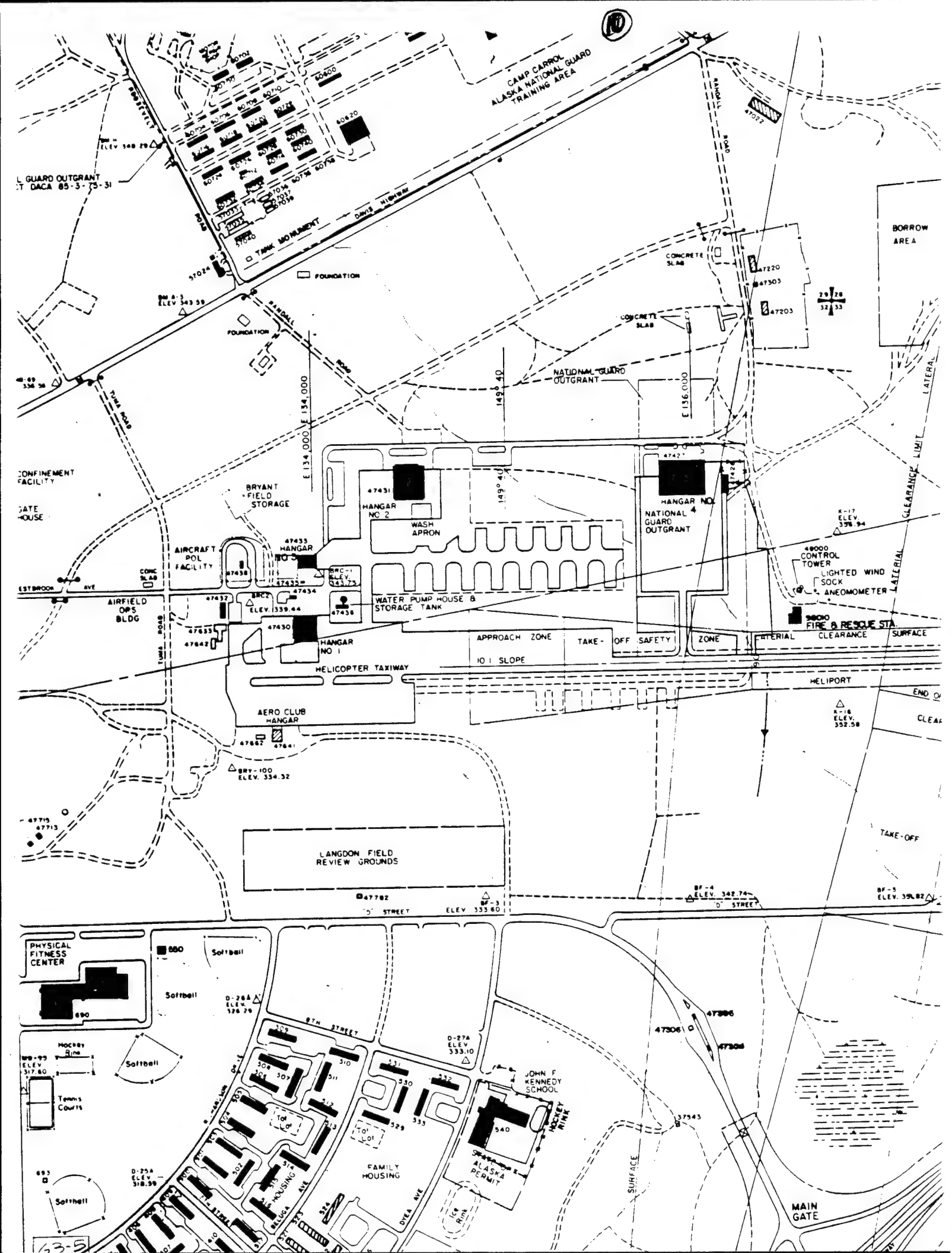









TENT AREA 4
NATIONAL GUARD OUTGRANT
CONTRACT DACA 85-3-75-31
WATER CIRC PUMP STA
WHSE
WHSE
REFRIGERATED WHSE
WAREHOUSE STREET
IMPOUND LOT
MOTOR REPAIR SHOP
OM SHOP
CIRCLE DRIVE
ENGINEER FIELD MAINT SHOP
MOTOR REPAIR SHOP
ORD FIELD MAINT SHOP
ORD FIELD MAINT SHOP
CONFINEMENT FACILITY
GATE HOUSE
VET FACILITY
DRIVERS TEST FACILITY
AIRFIELD OPS BLDG
WESTBROOK AVE
SIXTH STREET
TUNA ROAD
FOUNDATION
FOUNDATION
ROAD
ELECTRICAL REPAIR SHOP
TNG AIDS CENTER
ATTU HALL
DAVIS HIGHWAY
MOTOR REPAIR SHOPS
AUTO & CRAFT CENTER
WASH RACK
MOTOR REPAIR SHOP
STANDBY ELECTRICAL PLANT
MOTOR REPAIR SHOPS
WASH RACK
"D" STREET
BN HQ
BN HQ
PHYSICAL FITNESS CENTER
TRANSPORTATION MOTOR POOL
EM BARRACKS
EM BARRACKS
EM BARRACKS
EM BARRACKS
FIRST STREET
SECOND STREET
FIFTH STREET
SIXTH STREET
"B" STREET
"A" STREET
Ice Rink
Picnic Pavilion
EXCH BRANCH
RECREATION CENTER
CHAPEL
THEATER
DENTAL CLINIC
Football Field & Running Track
Baseball
Softball
Hockey Rink
Softball
Tennis Courts
PM ADMIN BLDG
BN HQ & SUPPLY
OCCU. HEALTH CLINIC
FLAGPOLE
G3-2
G3-3
G3-4
G3-5


CAMP CARROL
ALASKA NATIONAL GUARD
TRAINING AREA
BORROW
AREA
TANK MONUMENT
FOUNDATION
CONCRETE
SLAB
NATIONAL GUARD
OUTGRANT
E 134,000
149° 40'
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APRON
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4
NATIONAL
GUARD
OUTGRANT
BRYANT
FIELD
STORAGE
AIRCRAFT
POL
FACILITY
HANGAR
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CONTROL
TOWER
LIGHTED WIND
SOCK
ANEMOMETER
AIRFIELD
OPS
BLDG
WATER PUMP HOUSE &
STORAGE TANK
HANGAR
NO 1
APPROACH ZONE
TAKE-OFF
SAFETY
ZONE
CLEARANCE
SURFACE
10:1 SLOPE
HELICOPTER TAXIWAY
HELIPORT
AERO CLUB
HANGAR
LANGDON FIELD
REVIEW GROUNDS
D STREET
PHYSICAL
FITNESS
CENTER
Softball
Hockey
Rink
Tennis
Courts
87TH STREET
JOHN F
KENNEDY
SCHOOL
HOCKEY
RINK
FAMILY
HOUSING
ALASKA
PERMIT
MAIN
GATE
DYEA AVE
BELUGA AVE
TAKE-OFF
SURFACE
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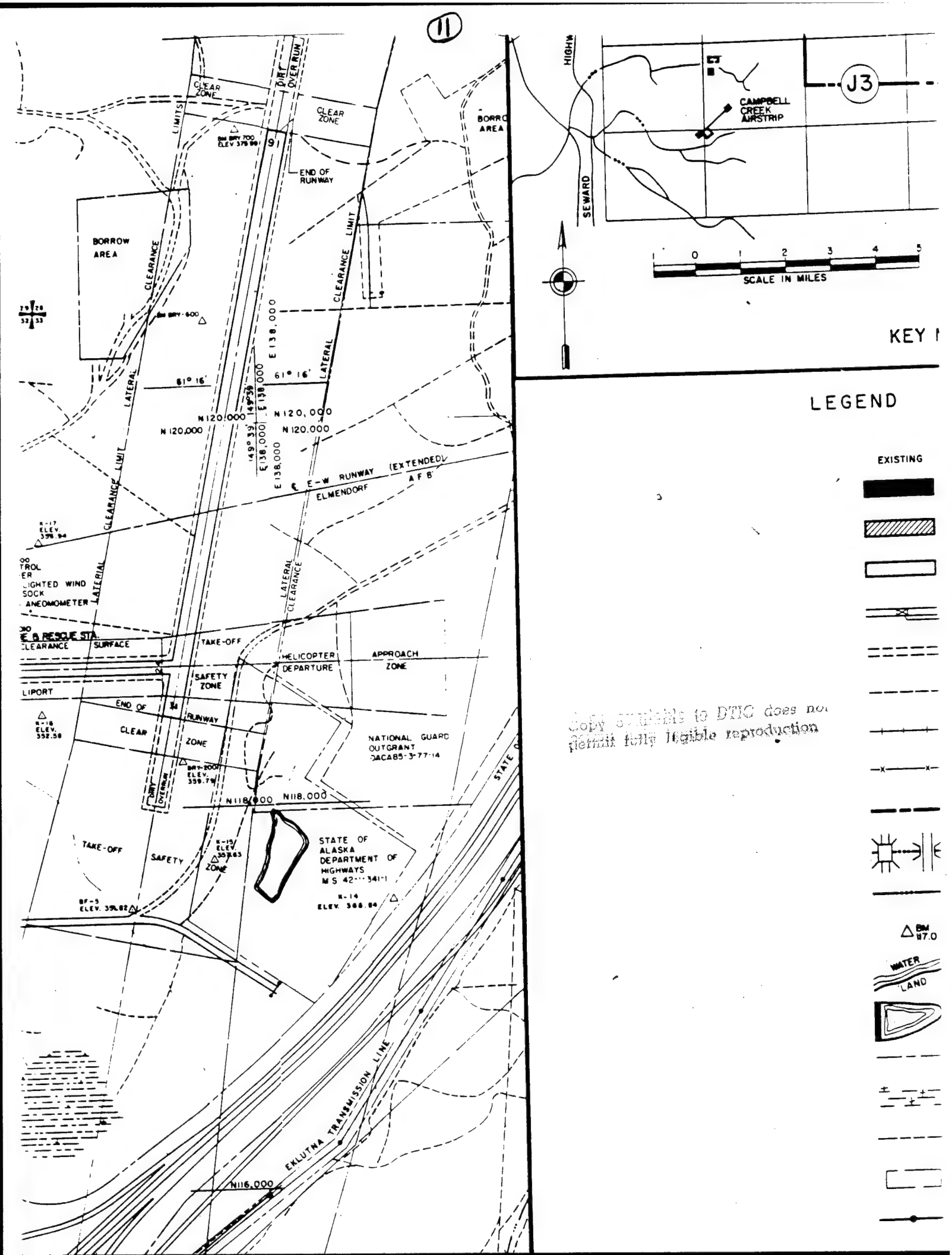
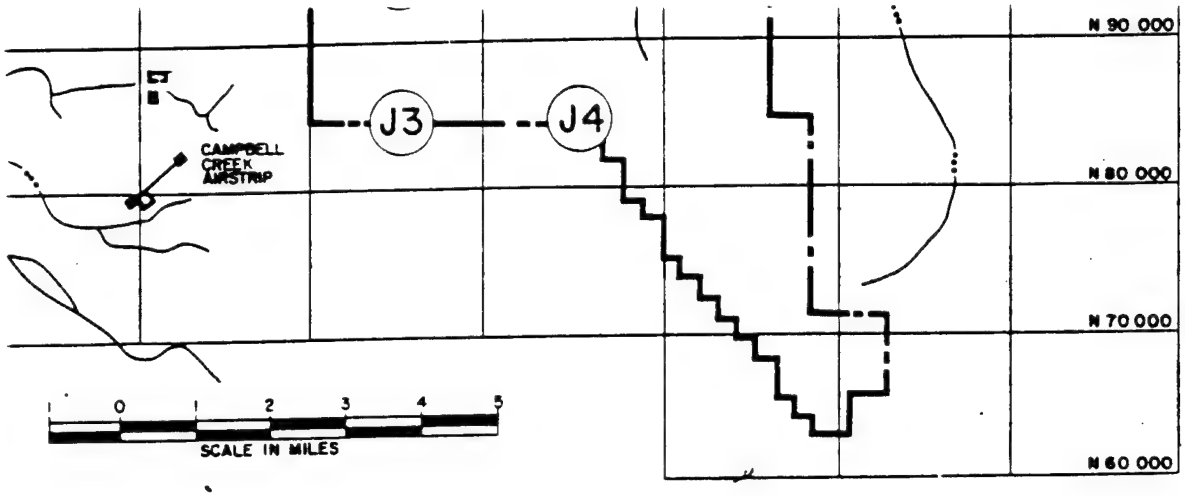


LEGEND

EXISTING

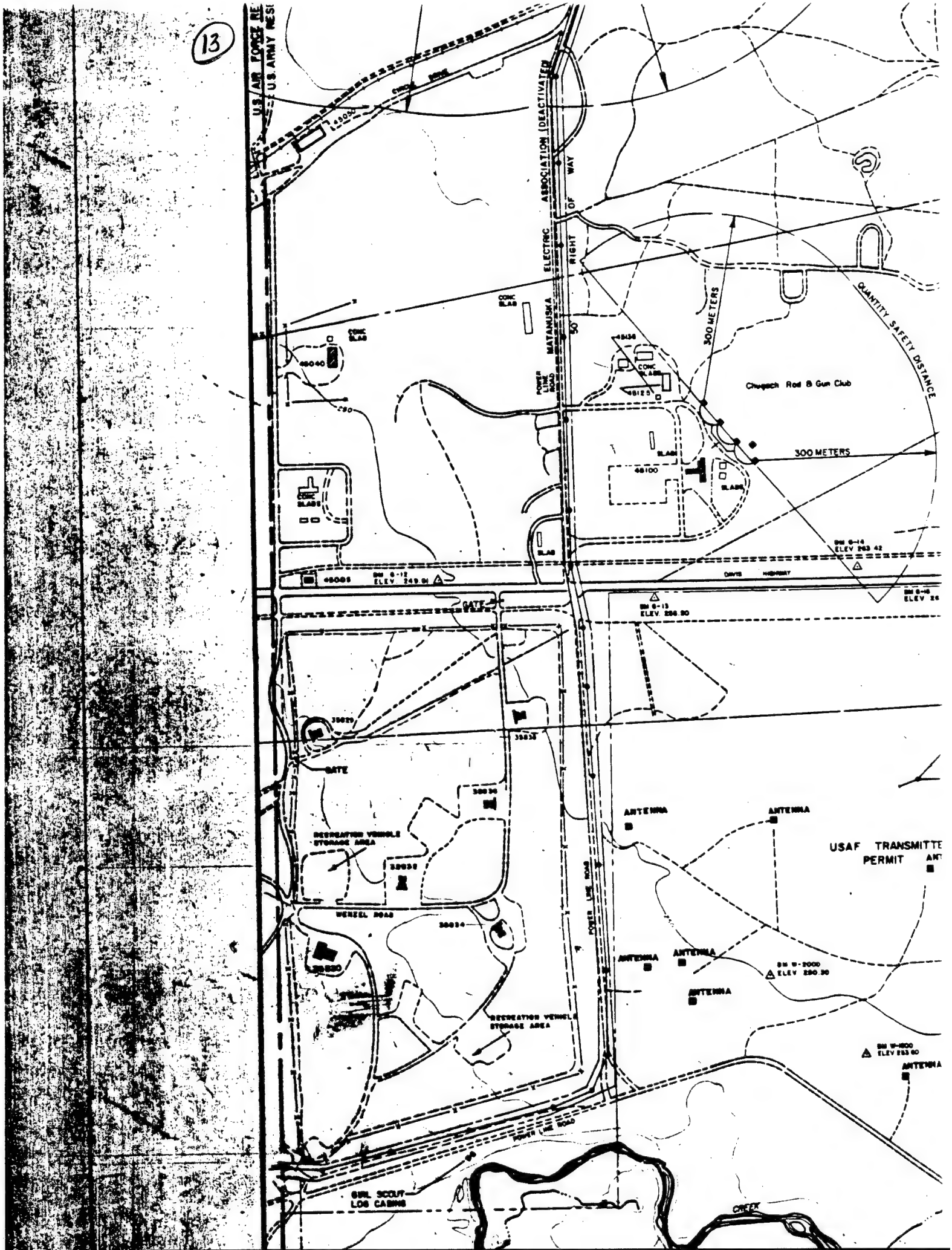


KEY MAP

LEGEND

EXISTING

- BUILDING, PERMANENT
- BUILDING, SEMI-PERMANENT
- BUILDING, TEMPORARY
- PAVEMENTS (roads, parking, etc.)
  TANK CROSSING
- IMPROVED ROADS
- TRAILS
- RAILROAD
- FENCE
- RESERVATION BOUNDARY
- BRIDGE, CULVERT
- DRAINAGE CHANNEL
- △ BM 17.0 — BENCH MARK
- WATER / LAND — SHORELINE
- DAM
- CENTER LINE
- MARSH AREA
- RIGHT OF WAY OR EASEMENT
- AREA LIMITS
- POWER OR COMMUNICATION LINE


13
U.S. AIR FORCE RE
U.S. ARMY RESI
ASSOCIATION (DEACTIVATED
ELECTRIC
RIGHT OF WAY
50
MATANUSKA
POWER LINE ROAD
300 METERS
QUANTITY SAFETY DISTANCE
Chugach Rod & Gun Club
300 METERS
CONC SLAB
DAVIS HIGHWAY
GATE
GATE
RECREATION VEHICLE STORAGE AREA
WERZEL ROAD
RECREATION VEHICLE STORAGE AREA
POWER LINE ROAD
ANTENNA
ANTENNA
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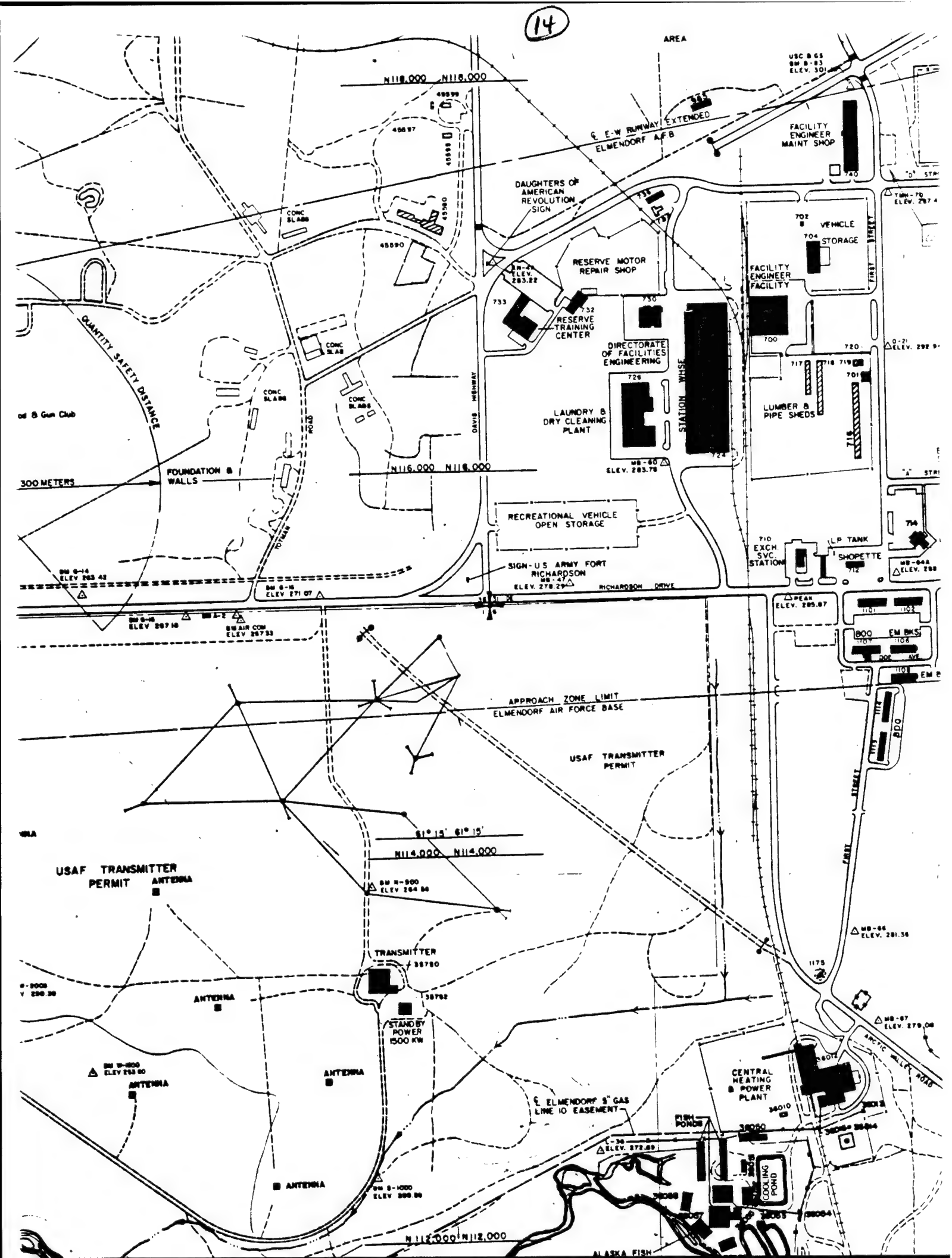
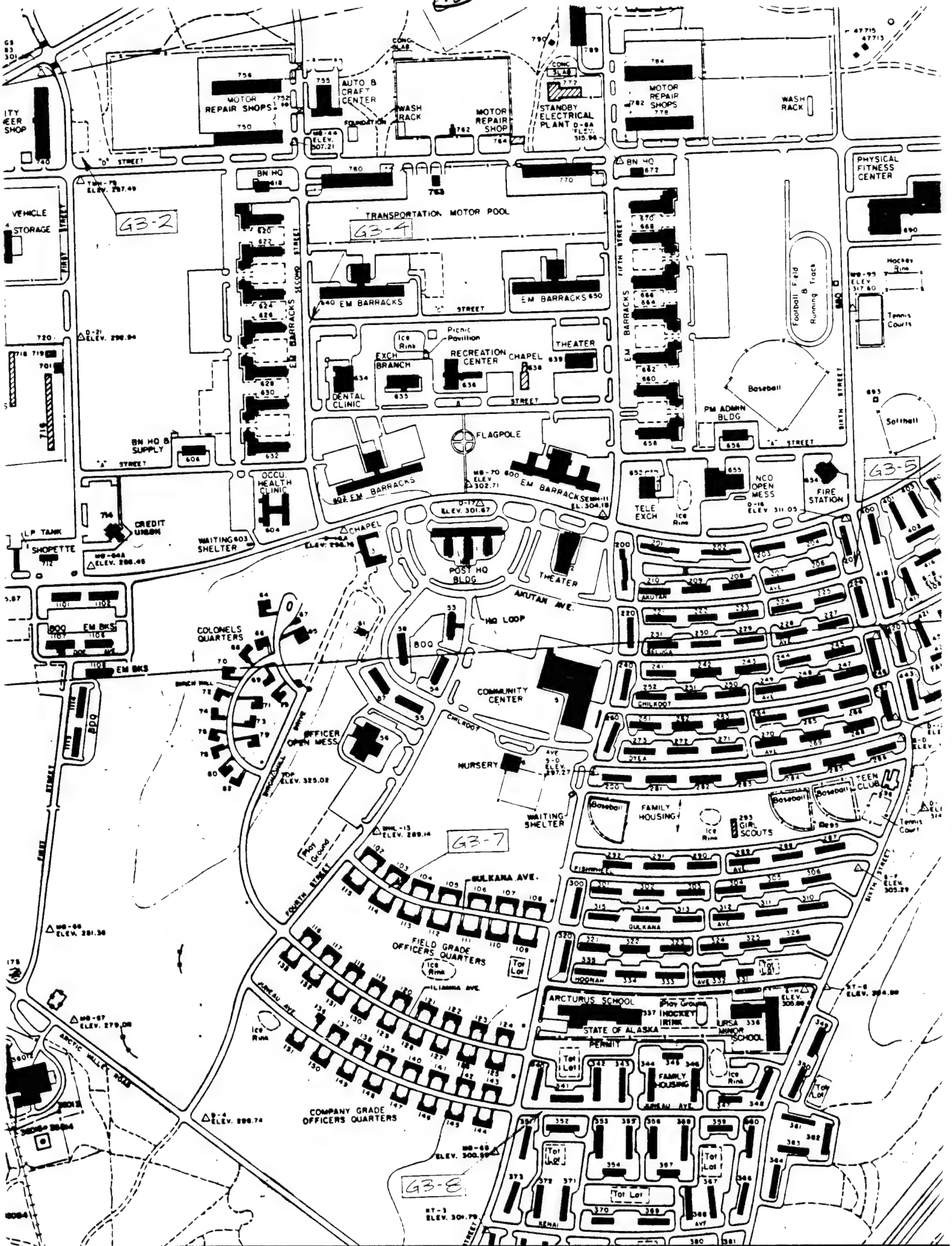
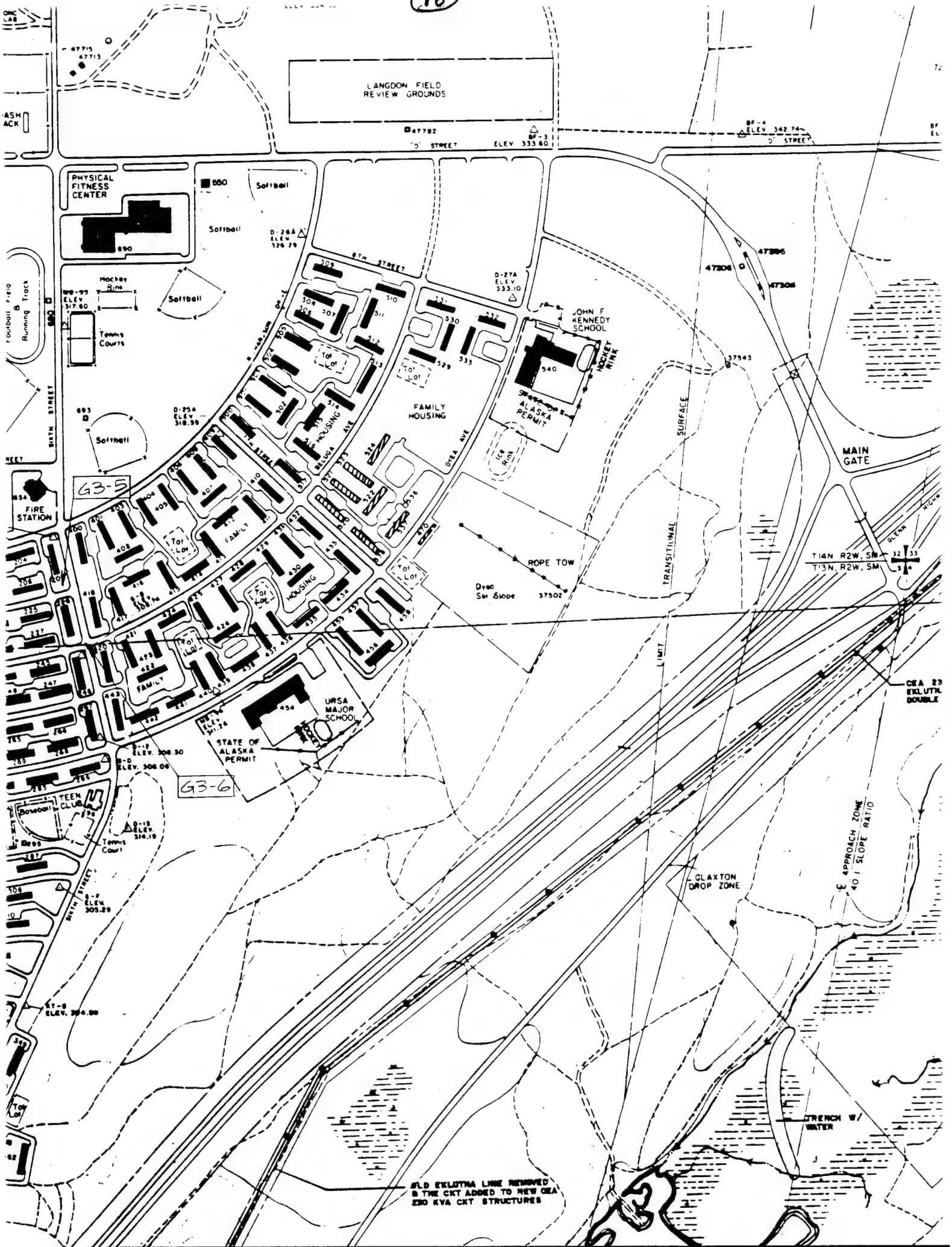
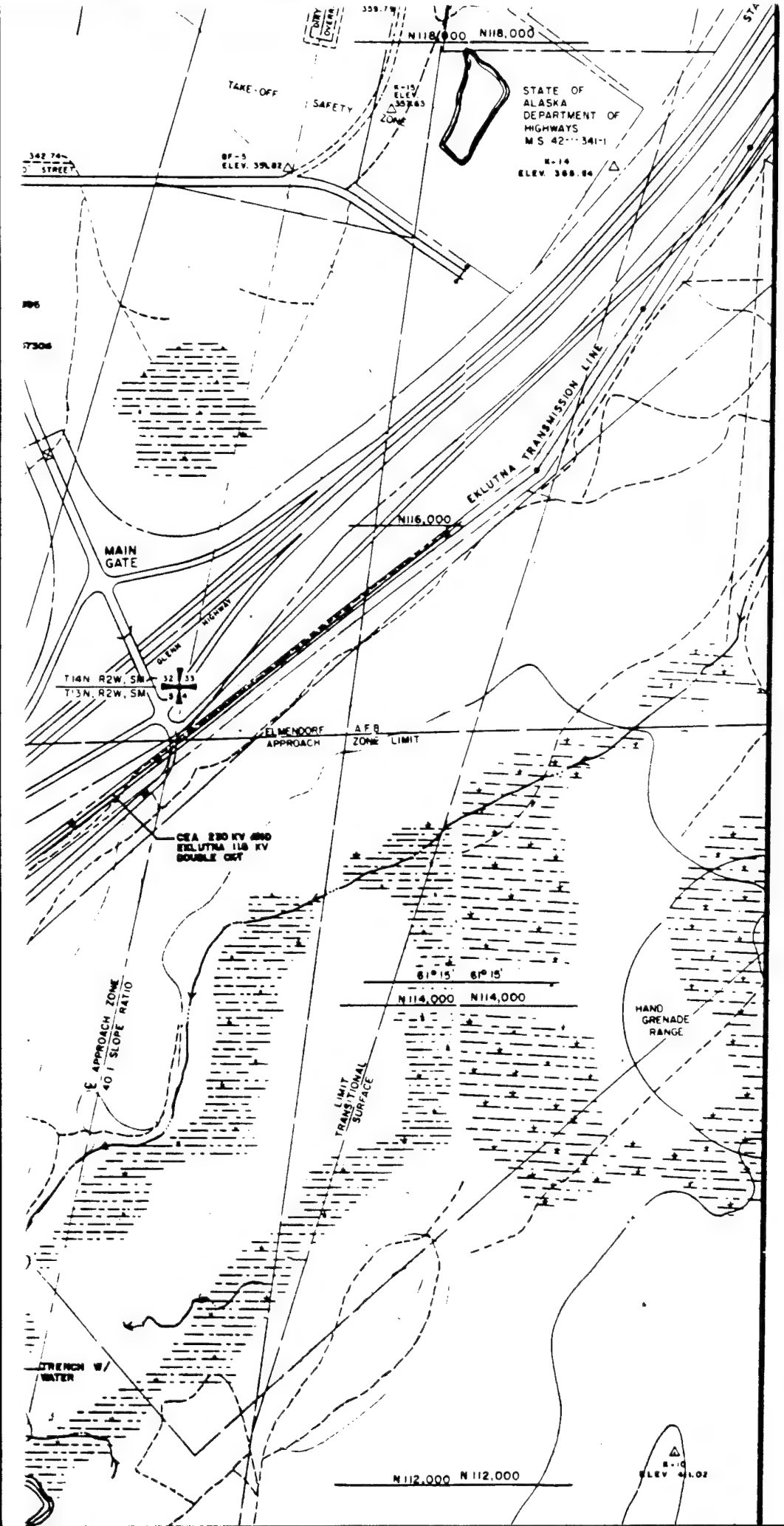
ANTENNA
ANTENNA
USAF TRANSMITTE
PERMIT
GIRL SCOUT LOG CABINS
CREEK


AREA
N118,000 N116,000
E-W RUNWAY EXTENDED
ELMENDORF A.F.B.
FACILITY ENGINEER MAINT SHOP
DAUGHTERS OF AMERICAN REVOLUTION SIGN
VEHICLE STORAGE
RESERVE MOTOR REPAIR SHOP
FACILITY ENGINEER FACILITY
RESERVE TRAINING CENTER
DIRECTORATE OF FACILITIES ENGINEERING
STATION WHSE
LAUNDRY & DRY CLEANING PLANT
LUMBER & PIPE SHEDS
QUANTITY SAFETY DISTANCE
300 METERS
FOUNDATION & WALLS
RECREATIONAL VEHICLE OPEN STORAGE
EXCH SVC STATION
LP TANK
SHOPETTE
SIGN-U.S. ARMY FORT RICHARDSON
RICHARDSON DRIVE
APPROACH ZONE LIMIT
ELMENDORF AIR FORCE BASE
USAF TRANSMITTER PERMIT
61° 15'
N114,000
USAF TRANSMITTER PERMIT ANTENNA
TRANSMITTER
ANTENNA
STAND BY POWER 1500 KW
CENTRAL HEATING & POWER PLANT
ELMENDORF 8" GAS LINE IO EASEMENT
FISH POND
COOLING POND
N112,000 N112,000
ALASKA FISH


G3-2
G3-4
G3-5
G3-7
G3-8
MOTOR REPAIR SHOPS
AUTO & CRAFT CENTER
WASH RACK
STANDBY ELECTRICAL PLANT
BN HQ
TRANSPORTATION MOTOR POOL
VEHICLE STORAGE
EM BARRACKS
RECREATION CENTER
CHAPEL
THEATER
EXCH BRANCH
DENTAL CLINIC
PHYSICAL FITNESS CENTER
Football Field
Running Track
Baseball
Softball
Hockey Rink
Tennis Courts
PM ADMIN BLDG
FLAGPOLE
OCCU. HEALTH CLINIC
BN HQ & SUPPLY
CREDIT UNION
SHOPETTE
WAITING SHELTER
POST HQ BLDG
NCO OPEN MESS
FIRE STATION
TELE EXCH
COLONELS QUARTERS
BOQ
EM BKS
HQ LOOP
AKUTAN AVE.
COMMUNITY CENTER
OFFICER OPEN MESS
NURSERY
CHILKOOT
DYEA
FAMILY HOUSING
TEEN CLUB
GIRL SCOUTS
GULKANA AVE.
FIELD GRADE OFFICERS QUARTERS
COMPANY GRADE OFFICERS QUARTERS
ARCTURUS SCHOOL
STATE OF ALASKA
PERMIT
URSA MINOR SCHOOL
HOONAH
ALMEDA AVE.
Tot Lot
Play Ground
Ice Rink
Picnic Pavilion
FIRST STREET
SECOND STREET
FOURTH STREET
FIFTH STREET
SIXTH STREET
"A" STREET
"B" STREET
"C" STREET
"D" STREET


LANGDON FIELD
REVIEW GROUNDS
"D" STREET
PHYSICAL FITNESS CENTER
Softball
Hockey Rink
Tennis Courts
Football Field & Running Track
BIRTH STREET
8TH STREET
JOHN F. KENNEDY SCHOOL
HOCKEY RINK
FAMILY HOUSING
BELUGA AVE
DYEA AVE
ALASKA PERMIT
SURFACE
MAIN GATE
FIRE STATION
G3-5
ROPE TOW
Dyea Ski Slope
TRANSITIONAL
LIMIT
T14N R2W, SM
T13N, R2W, SM
URSA MAJOR SCHOOL
STATE OF ALASKA PERMIT
G3-6
TEEN CLUB
Tennis Court
GLAXTON DROP ZONE
APPROACH ZONE 40:1 SLOPE RATIO
CEA 23 EKLUTNA DOUBLE
TRENCH W/ WATER
OLD EKLUTNA LINE REMOVED & TWE CKT ADDED TO NEW CEA 230 KVA CKT STRUCTURES



NOTE
1. NO HISTORIC PLACES NOTED ON THI
2. NO FLOOD HAZARD EXIST

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FORT

ROBERT G. MUIR & ASSOCIATES
ARCHITECTS & PLANNERS
COLORADO SPRINGS, COLORADO

(18)

RESERVATION BOUNDARY

BRIDGE, CULVERT

DRAINAGE CHANNEL

BM 117.0 BENCH MARK

WATER LAND SHORELINE

DAM

CENTER LINE

MARSH AREA

RIGHT OF WAY OR EASEMENT

AREA LIMITS

POWER OR COMMUNICATION LINE

PIPE LINE

SECTION CORNER, QUARTER SECTION CORNER

INDEX CONTOUR

INTERMEDIATE CONTOUR

DEPRESSION

G3-5 IDENTIFICATION OF LEAK LOCATION

WATERLINE NOT CHECKED PER S.O.W.

CO

TE
NO HISTORIC PLACES NOTED ON THIS MAP.
NO FLOOD HAZARD EXIST.

N

00 0 00 00 00

SCALE IN FEET

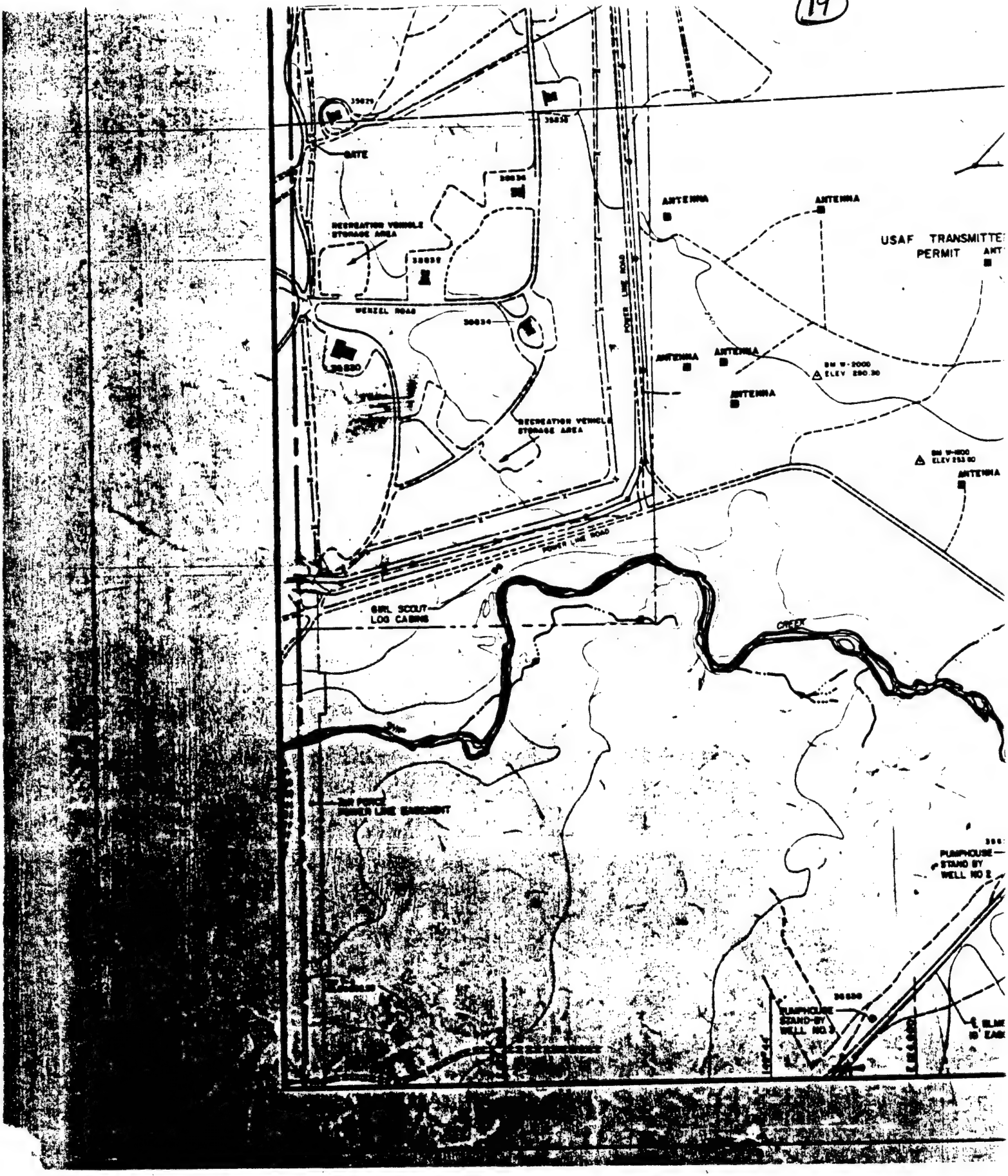
CONTOUR INTERVAL 10 FEET
(25' INTERVAL OUTSIDE RESERVATION)

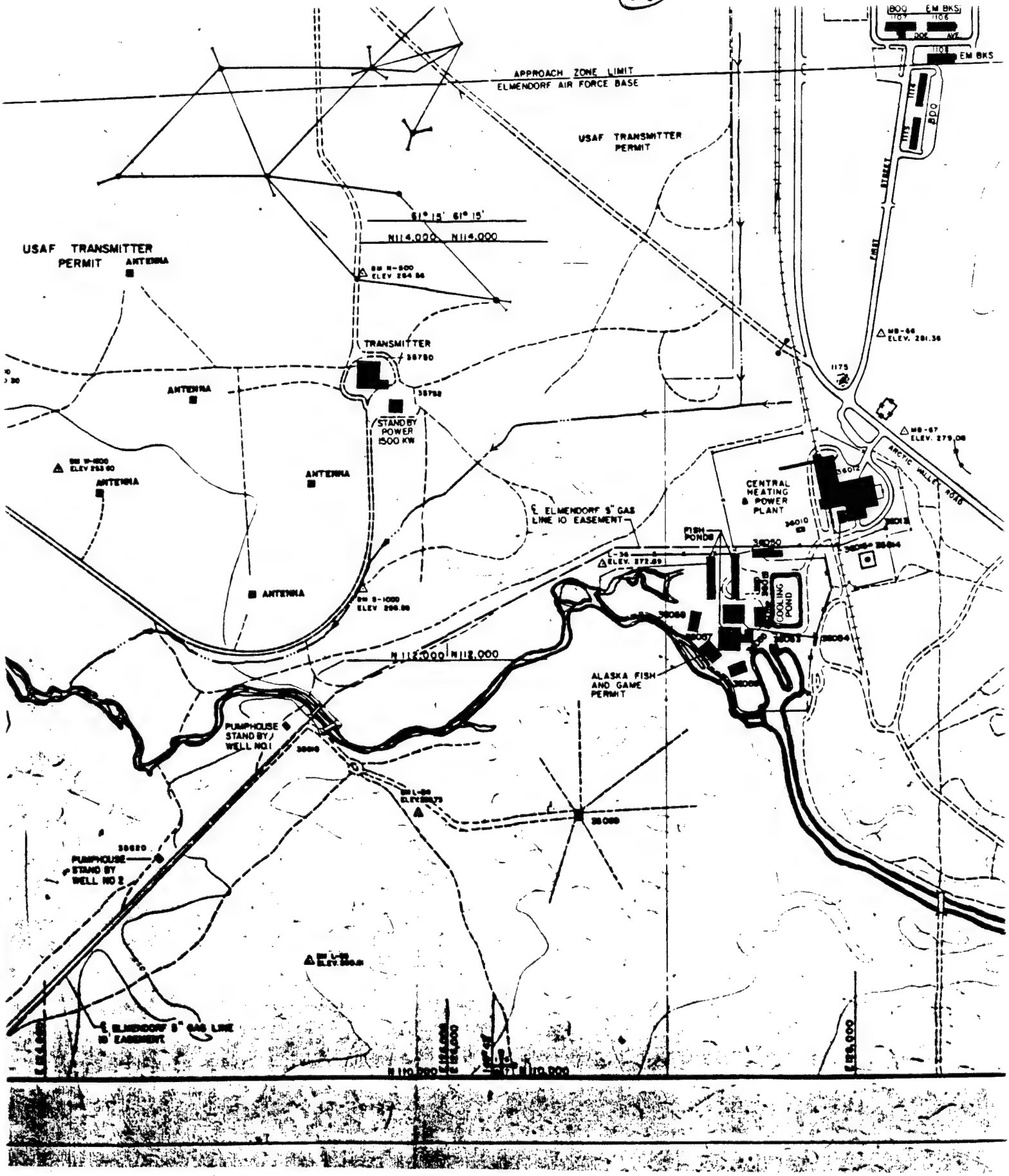
FORT RICHARDSON

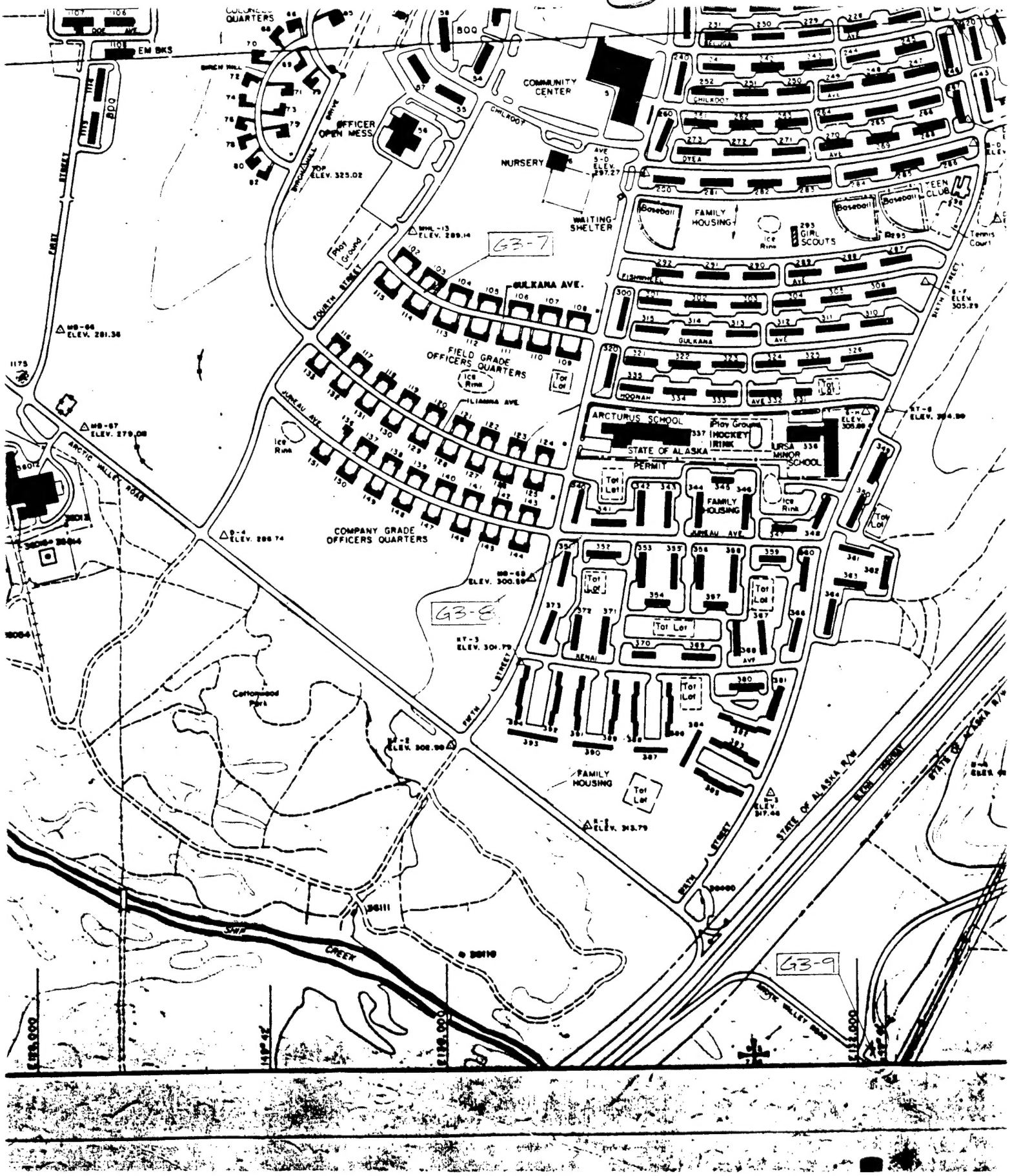
ANCHORAGE, ALASKA

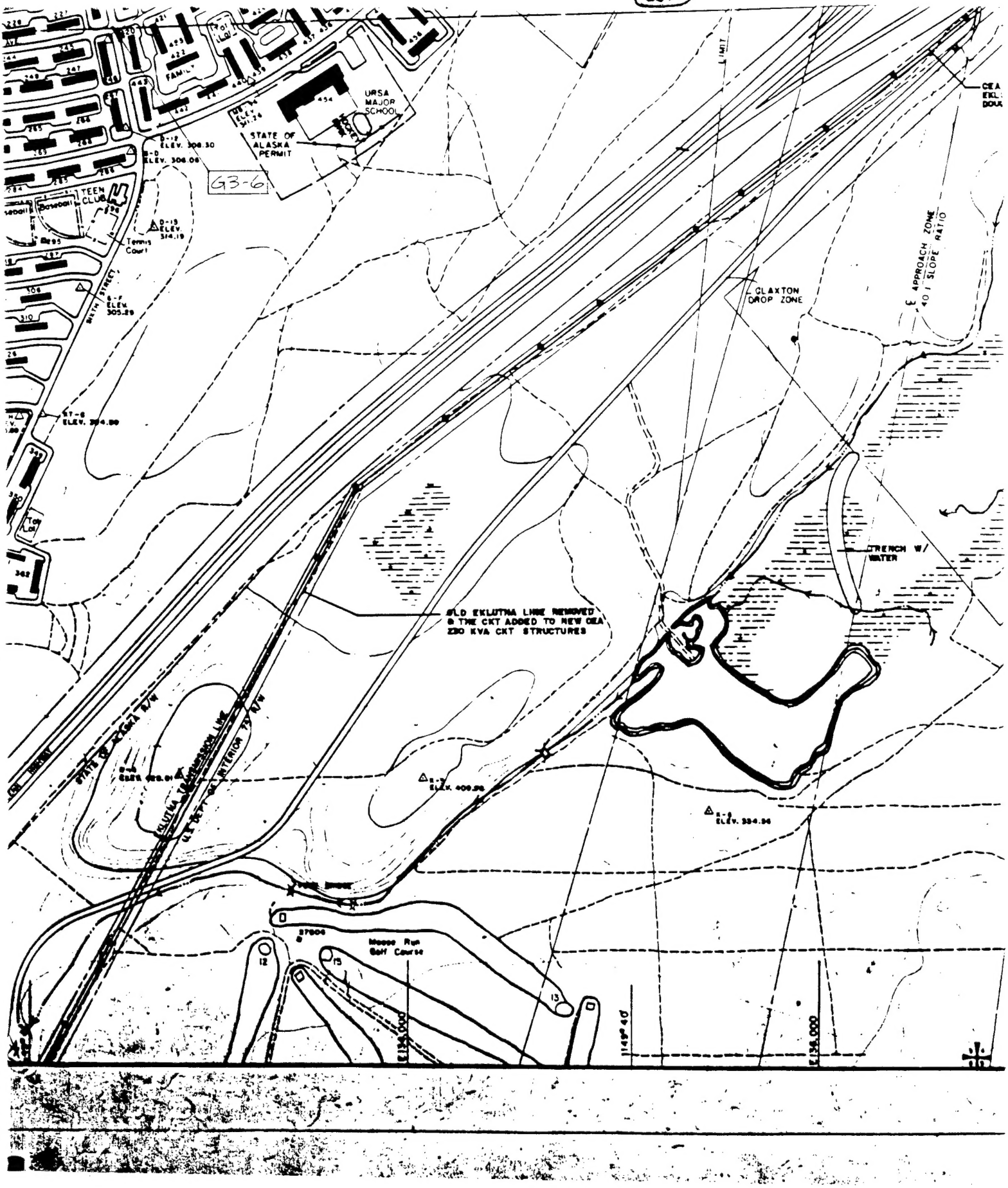
ROBERT G. MUIR & ASSOCIATES
ARCHITECTS & PLANNERS
OLORADO SPRINGS, COLORADO 80903

U.S. ARMY ENGINEER DISTRICT, ALASKA
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

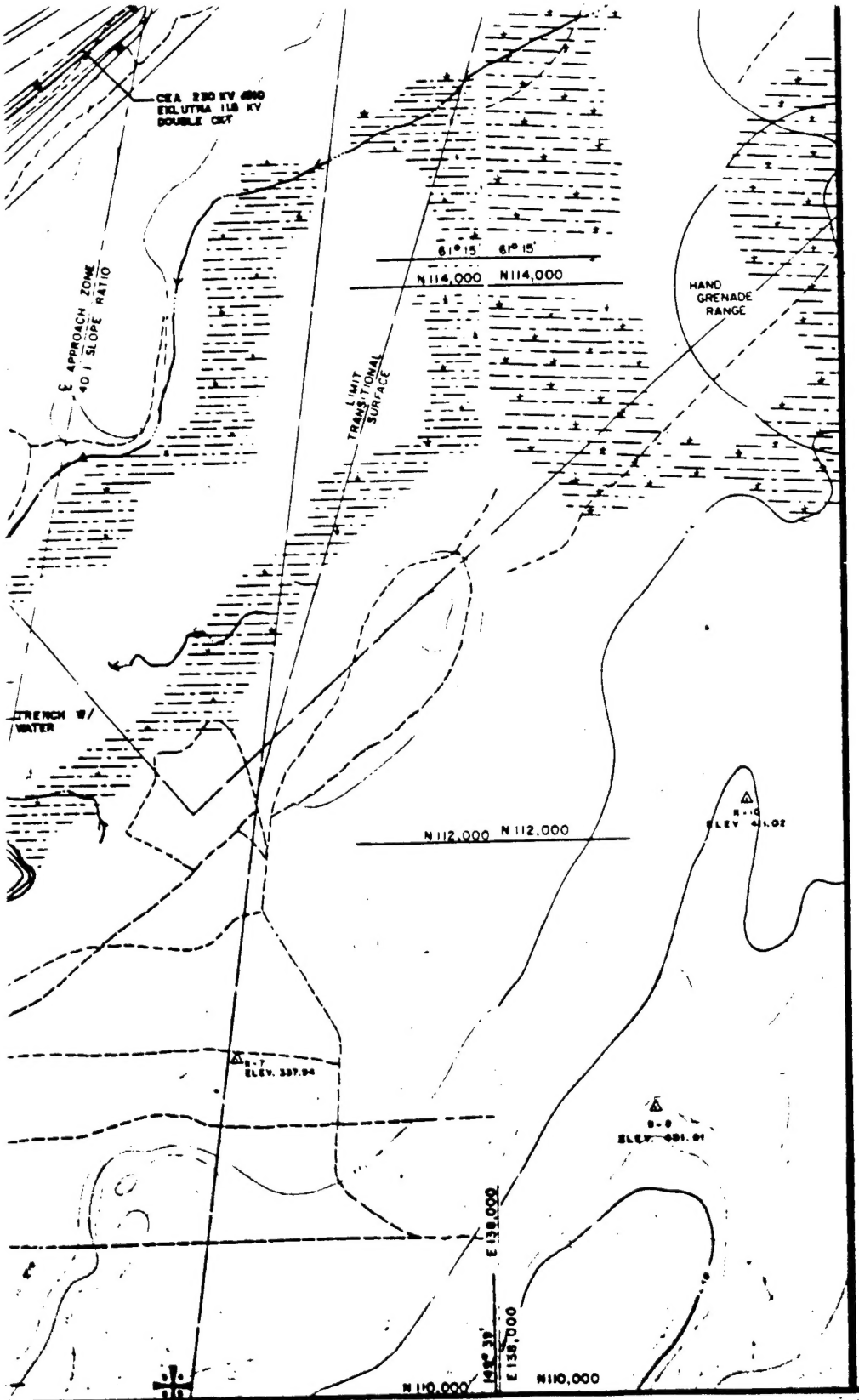

GATE
RECREATION VEHICLE STORAGE AREA
WENZEL ROAD
POWER LINE ROAD
ANTENNA
ANTENNA
USAF TRANSMITTE
PERMIT
ANTENNA
ANTENNA
ANTENNA
BM W-2000
ELEV 290.30
BM W-1000
ELEV 253.80
ANTENNA
RECREATION VEHICLE STORAGE AREA
POWER LINE ROAD
GIRL SCOUT LOG CABINS
CREEK
PUMPHOUSE STAND-BY WELL NO 3
PUMPHOUSE STAND BY WELL NO 2


APPROACH ZONE LIMIT
ELMENDORF AIR FORCE BASE
USAF TRANSMITTER PERMIT
USAF TRANSMITTER PERMIT
ANTENNA
61° 15'
61° 15'
N114,000
N114,000
TRANSMITTER
STAND BY POWER 1500 KW
ANTENNA
ANTENNA
ANTENNA
ANTENNA
℄ ELMENDORF 8" GAS LINE 10' EASEMENT
CENTRAL HEATING & POWER PLANT
FISH POND
COOLING POND
ARCTIC WARFARE ROAD
EM BKS
EM BKS
N112,000
N112,000
ALASKA FISH AND GAME PERMIT
PUMPHOUSE STAND BY WELL NO.1
PUMPHOUSE STAND BY WELL NO.2
℄ ELMENDORF 8" GAS LINE 10' EASEMENT
E 124,000
E 126,000
E 128,000
E 129,000
N 110,000
N 110,000




URSA MAJOR SCHOOL
STATE OF ALASKA PERMIT
G3-6
TEEN CLUB
Tennis Court
CLAXTON DROP ZONE
E APPROACH ZONE 40:1 SLOPE RATIO
TRENCH W/ WATER
OLD EKLUTNA LINE REMOVED & THE CKT ADDED TO NEW CEA 230 KVA CKT STRUCTURES
EKLUTNA TO ANCHORAGE LINE
STATE OF ALASKA R/W
Moose Run Golf Course
12
13
15
E 134,000
E 136,000

(23)



NOTE
1. NO HISTORIC PLACES NOTED ON THIS F
2. NO FLOOD HAZARD EXIST

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(25'

FORT

ROBERT G. MUIR & ASSOCIATES
ARCHITECTS & PLANNERS
COLORADO SPRINGS, COLORADO

BUI

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FO

DATE

REVIEWED & COMMENTED ON BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS.

DATE

(24)

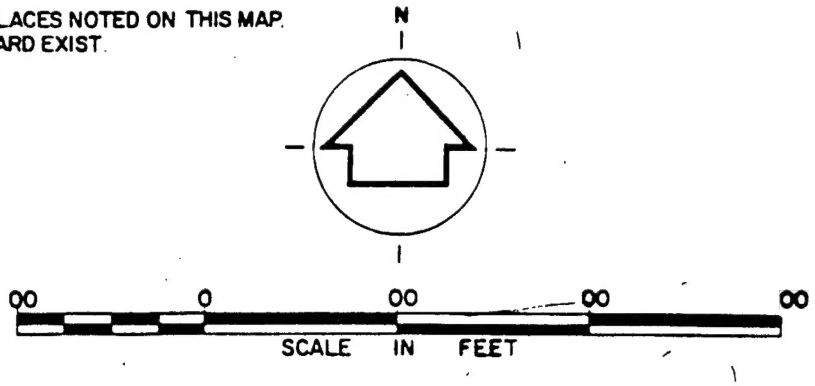
INTERMEDIATE CONTOUR

DEPRESSION

G3-5 IDENTIFICATION OF LEAK LOCATION

WATERLINE NOT CHECKED PER S.O.W.

HISTORIC PLACES NOTED ON THIS MAP.
FLOOD HAZARD EXIST.



CONTOUR INTERVAL 10 FEET
(25' INTERVAL OUTSIDE RESERVATION)

FORT RICHARDSON

ANCHORAGE, ALASKA

ROBERT G. MUIR & ASSOCIATES ARCHITECTS & PLANNERS COLORADO SPRINGS, COLORADO 80903	U.S. ARMY ENGINEER DISTRICT, ALASKA CORPS OF ENGINEERS ANCHORAGE, ALASKA

MASTER PLAN

BASIC INFORMATION MAPS

BUILDING AREA MAP

THE INSTALLATION PLANNING BOARD FOR APPROVAL

H.A. FROEHLE
Colonel, Corps of Engineers
Director of Facilities Engineering

APPROVED ON BY MAJOR COMMANDER
THE CHIEF OF ENGINEERS.

DATE
1 FEB 1963

DRAWING NO.
18-0-18

SHEET NO.
4 OF 216

FILE NO.

BASIC INFORMATION
FOR MASTER PLAN